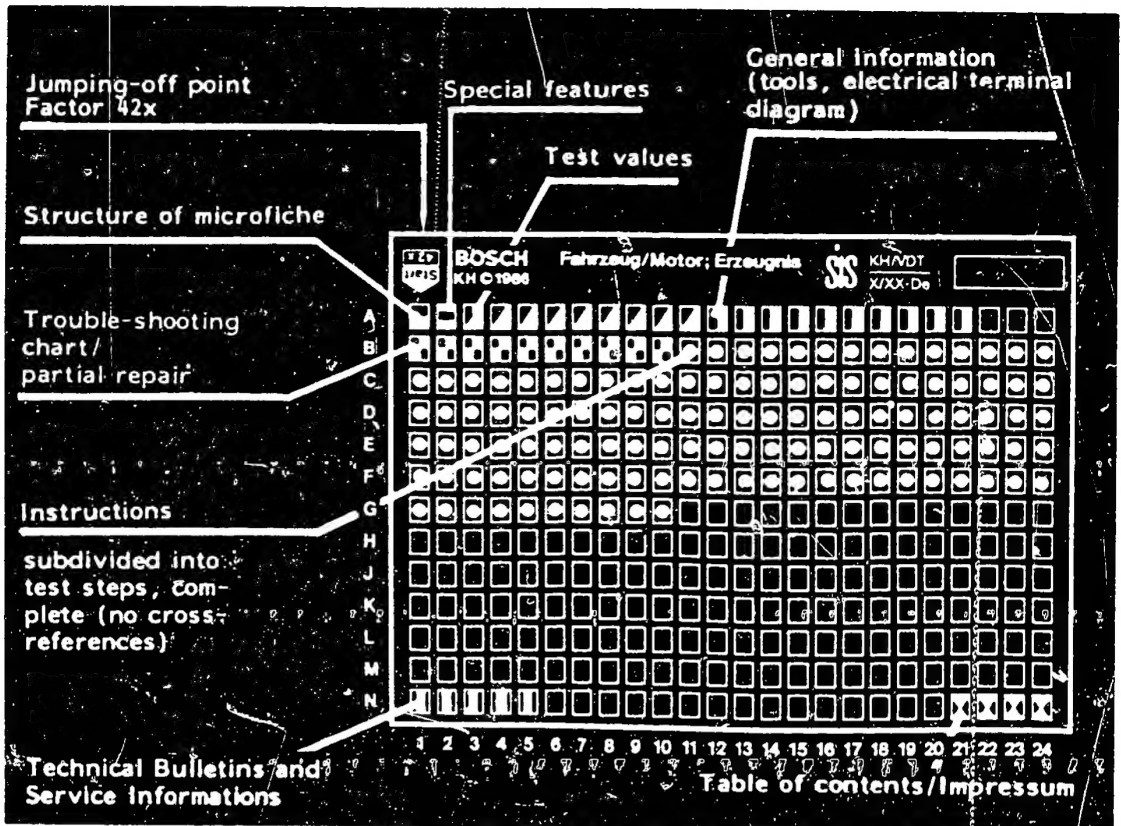


Structure of microfiche



1. Read from left to right
2. Title of microfiche (appears on each coordinate)

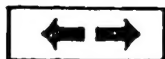
E16	Product/component/test step
	Vehicle/engine

Coordinate

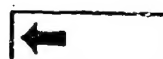
3. Limits of section



Beginning



Mid-section



End



One-page section

4. References to relevant test steps in test specifications; coordinate e.g. C6

C6

A1

Trouble-shooting program



1. Special features

Repair instructions for PES.. M.. series in-line injection pumps with and without FBG system, without governor, ADA, and timing device.

Attention will be drawn to peculiarities which must be borne in mind in pumps with FBG system.

The repair of the different types of governors is carried out per the appropriate repair instructions.



2. Test specifications

2.1 Camshaft projection (between fluid-level gauge and pump housing)

Only on pumps with pneumatic governor

Nominal: 9.0 - 10.0 mm

2.2 Axial play of camshaft

Pumps with deep-groove ball bearings:

Setting tolerance: 0.03...0.13 mm

Test tolerance 0.01...0.15 mm

2.3 Leak test (suction gallery)

Test duration and pressure: 4 minutes at 5 bar



2.4 Leak test (camshaft chamber etc.)

Test duration and pressure:

3 minutes at 1.5 bar, thereafter

1 minute at 0.5 bar

2.5 Instructions for setting prestroke:

0.3mm roller diameter corresponds to 1° angular cam spacing, test pressure 30 + 2 bar

2.6 Position numbers

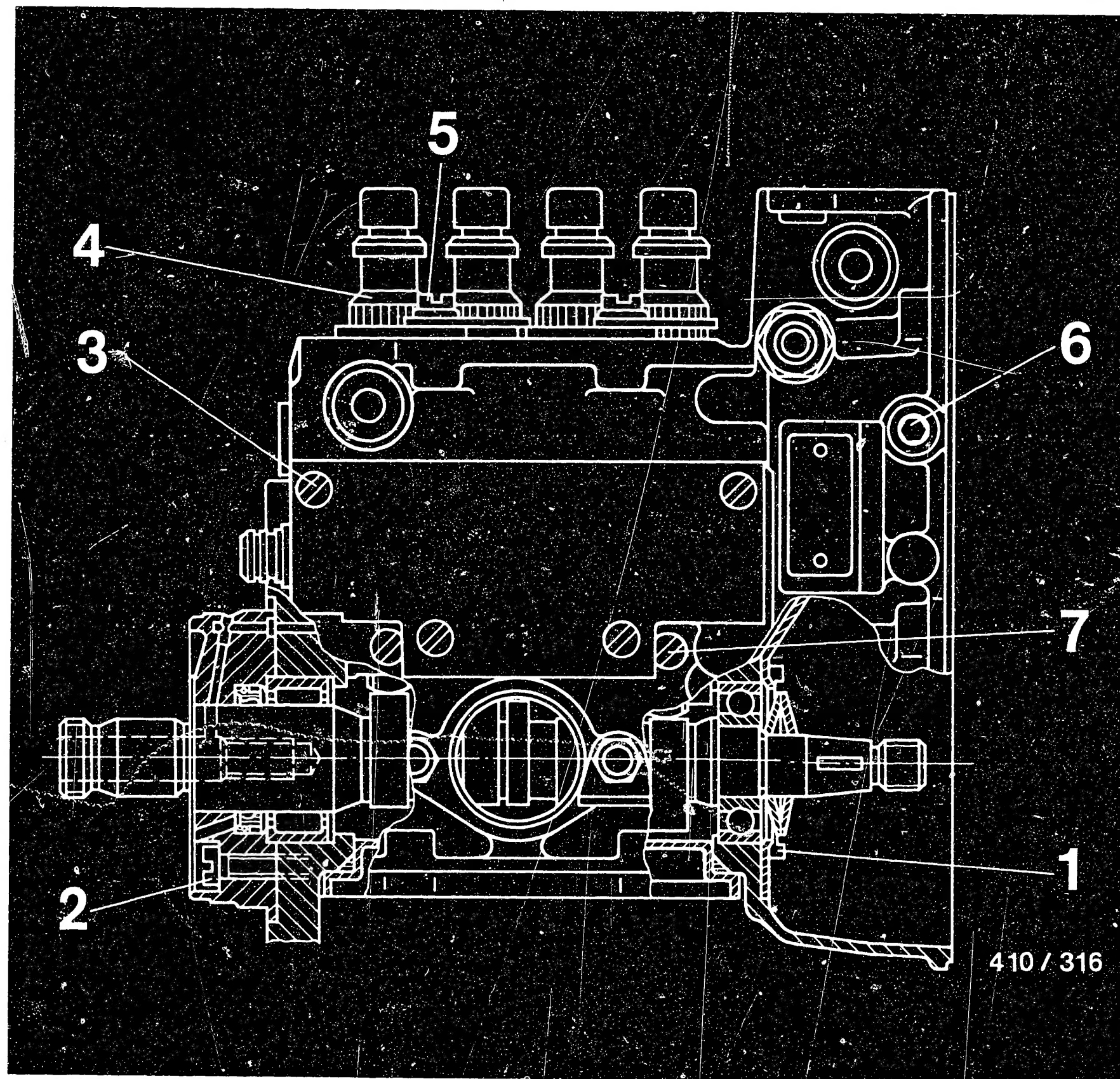
Position numbers occurring in the text do not correspond to the position numbers of the service-parts list.

2.7 Tightening torques

On the following coordinates, bolts, nuts, etc. are numbered in drawings.

On the right next to the drawings these numbers are repeated and matched with the coordinates where the tightening torques can be found.





Position	Coordinates
1	A 11
2	A 11
3	A 11
4	A 11
5	A 11
6	A 11
7	A 11

A5

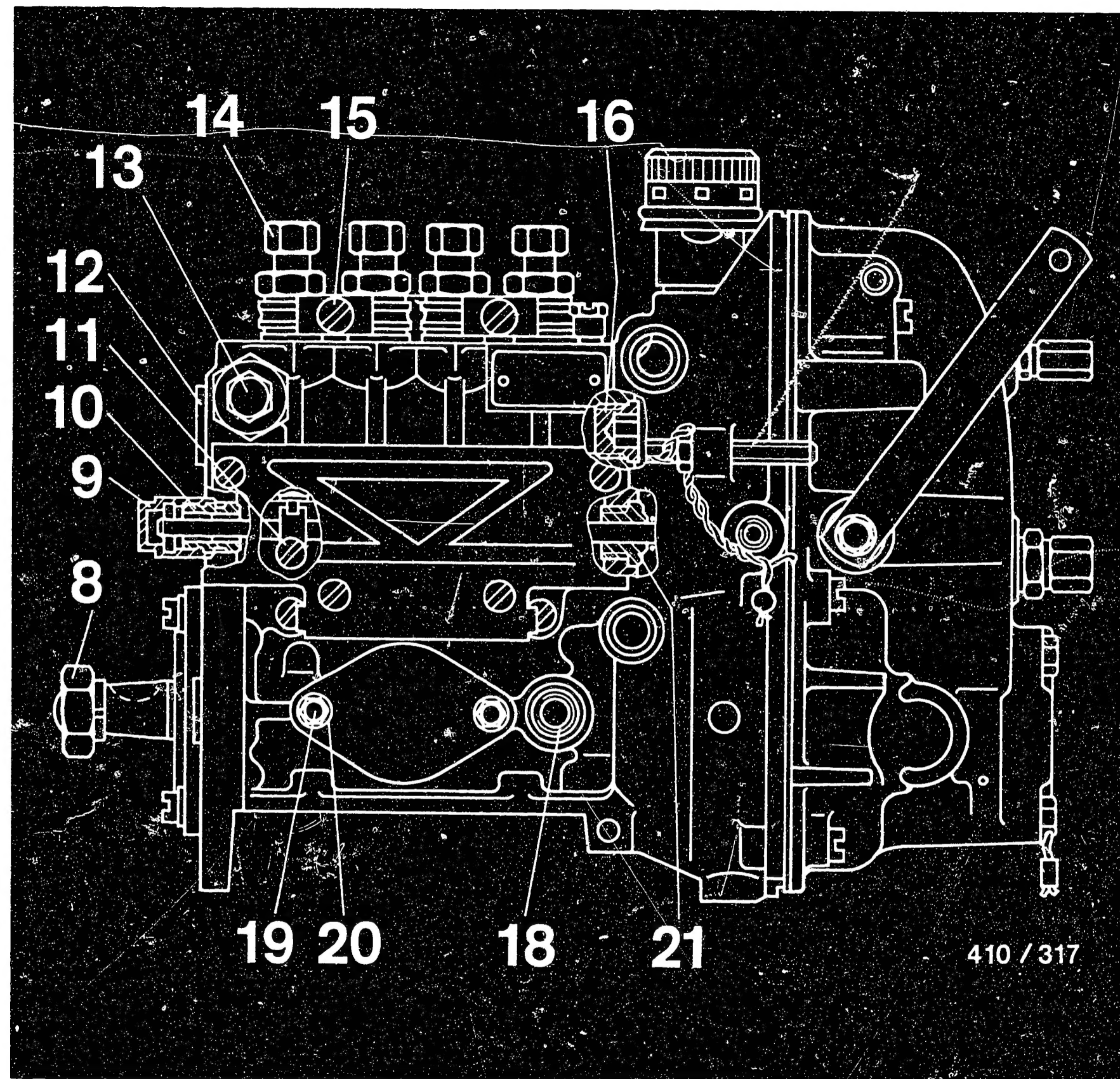
Test specifications
PES..M.., 0 410..



A6

Test specifications
PES..M.., 0 410..





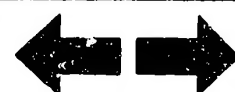
Position	Coordinate
8	A 11
9	A 11
10	A 11
11	A 11
12	A 11
13	A 11
14	A 11
15	A 11
16	A 11
18	A 11
19	A 11
20	A 11

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A7

Test specifications

PES..M.., 0 410..



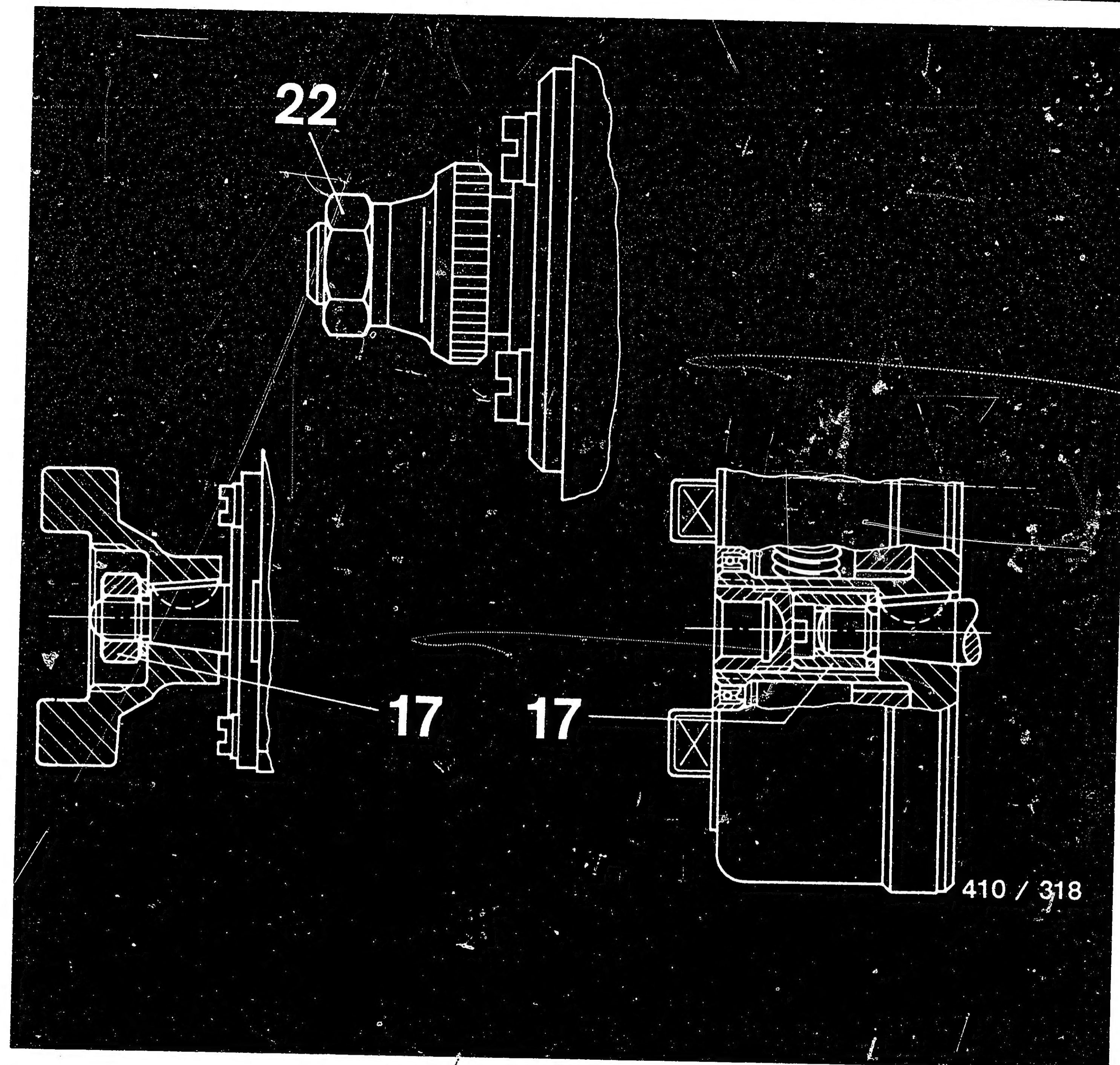
A8

Test specifications

PES..M.., 0 410..



Position	Coordinate
17	A 11
22	A 11



A9

Test specifications
PES..M.., 0 410..



A10

Test specifications
PES..M.., 0 410..



Tightening torques

Pos.	Description	Nm
1	Fastening screw for bearing and plate	7...9
2	Fastening screw for bearing and plate	7...9
3	Fastening screw for spring-chamber cover	7...9
4	Delivery-valve holder with serration	15...25... 30 + 5
	Delivery-valve holder with hexagon	30...0...30... 0...30 + 5
5	Fillister-head screw	7...9
6	Control-rod stop screw	9...12
7	Roller-tappet guide screw	9...12
8	Hexagonal nut	60...70
9	Control-rod closure cap	10
10	Control-rod guide sleeve	20...30
11	Fillister-head screw	3...5
12	Threaded bushing or screw plug	30...40
13	Threaded bushing	30...40
14	Union nut	max. 25
15	Fillister-head screw	5...6.5
16	Screw plug	30...35
17	Timing device and coupling	45...55
18	Reducer bushing	
	Thread M 14x1.5	20...25
	Thread M 16x1.5	30...35
19	Threaded pin	3...4
20	Hexagonal nut	5...7
21	Control-rod guide bushing	30...40
22	Hexagonal nut/drive gear	60...70



3. General information

- Always replace camshaft bearings, individual worn or damaged parts, and seals.
- Injection-pump parts which are to be stored for long periods of time should be covered and protected against rust.

3.1 Lubrication

Radial-lip-type oil seal	Lightly oil with lubricating oil 5 962 260 605
Assemblies and delivery valves	Wash in cleaning agent, pistons with calibrating oil
O-rings Double-lip sealing ring	Grease with tallow (commercially available). Fill the space between sealing lips with high melting-point grease 5 700 002 025.

3.2 Cleaning the parts

Wash the parts in a commercially-available flame-resistant cleaning agent, e.g. chlorothene NU. Subsequently blow dry with compressed air.

3.3 In order to prevent possible irritation to the skin by immersion in calibrating oil, before testing the suction gallery and camshaft chamber for leakage rub a skin-protective cream into the hands, and wash with soap and water after testing.



3.4 Safety regulations for handling combustible liquids

Regulation on work with combustible liquids (VbF) from the West German Federal Ministry of Labor (BmA).

Safety rules for handling chlorinated hydrocarbons,
for firms ZH 1/222

for individuals ZH 1/119

from the Hauptverband für Gewerbliche
Berufsgenossenschaften (Zentralverband für
Unfallschutz und Arbeitsmedizin) Langwartweg 103, 5300
Bonn 5.

Outside West Germany, observe corresponding local
regulations.

A13

General information

PES..M..., 0 410..



4. Tools, equipment, lubricants

Description	Part number	Application
Flange	1 685 720 208	77 mm dia. pilot
Flange	1 685 720 018	68 mm dia. pilot
Coupling	1 416 430 012	for 17 mm dia. cone
Coupling	1 686 432 019	drive coupling with serration
Clamping bracket	1 688 010 010	for test benches with 125 mm peak height
Measuring tool	0 681 440 017	measuring prestroke
Dial indicator	1 687 233 011	measuring prestroke
Tappet holder consisting of: 3 holding plates for 4 and 5-cyl. pumps without FBG system, 4, 5, and 6-cyl. pumps with FBG system, 1 set tappet holders (6 pcs.), 1 set tappet holders (5 pcs.)	KDEP 1563	positioning roller tappets
Press-in tools	KDEP 1567	pressing in drive bearings
Press-out tools	KDEP 1566	pressing out drive bearings
Press-in tool	KDEP 1576	pressing in radial-lip-type oil seal on drive end



Description	Part number	Application
Plunger pliers	KDEP 2915	holding pump plungers during assembly and dis-assembly
Puller	KDEP 1131	pulling off drive gear
Clamping support	KDEP 2919	clamping the injection pump
Socket wrench	KDEP 1044	delivery-valve holder with serration
Test bell	KDEP 1045	leak test of injection pump
Test bell	KDEP 1565	leak test of injection pump
Holding plate	KDEP 2913	leak test of suction gallery
Hand miller	KDEP 2956	dressing assembly seat supports
Holding wrench	KDEP 2906	counterholding and turning the camshaft
Fluid-level gauge	KDEP 2899	calibrating projection
Axial play measuring tool	KDEP 2890	Measuring axial play of camshaft



Description	Part number	Application
Press-in tool	KDEP 1049	pressing on/in camshaft bearing
Mounting sleeve	KDEP 2874	protecting drive-end radial-lip-type oil seal
Clamping tool	KDEP 1545	counterholding during installation of flyweight
Holding tool	KDEP 1077	flyweight assembly on IP's with FBG
Mounting device	KDEP 1505	pressing down roller tappets
Reamer	KDEP 2996	reaming out control-rod guide bushings
Pressing plate	KDEP 1580	pressing off camshaft bearings
Press-out sleeve	KDEP 1588	pressing out camshaft, IP's with FBG system
Clamping support	KDEP 2919	clamping IP

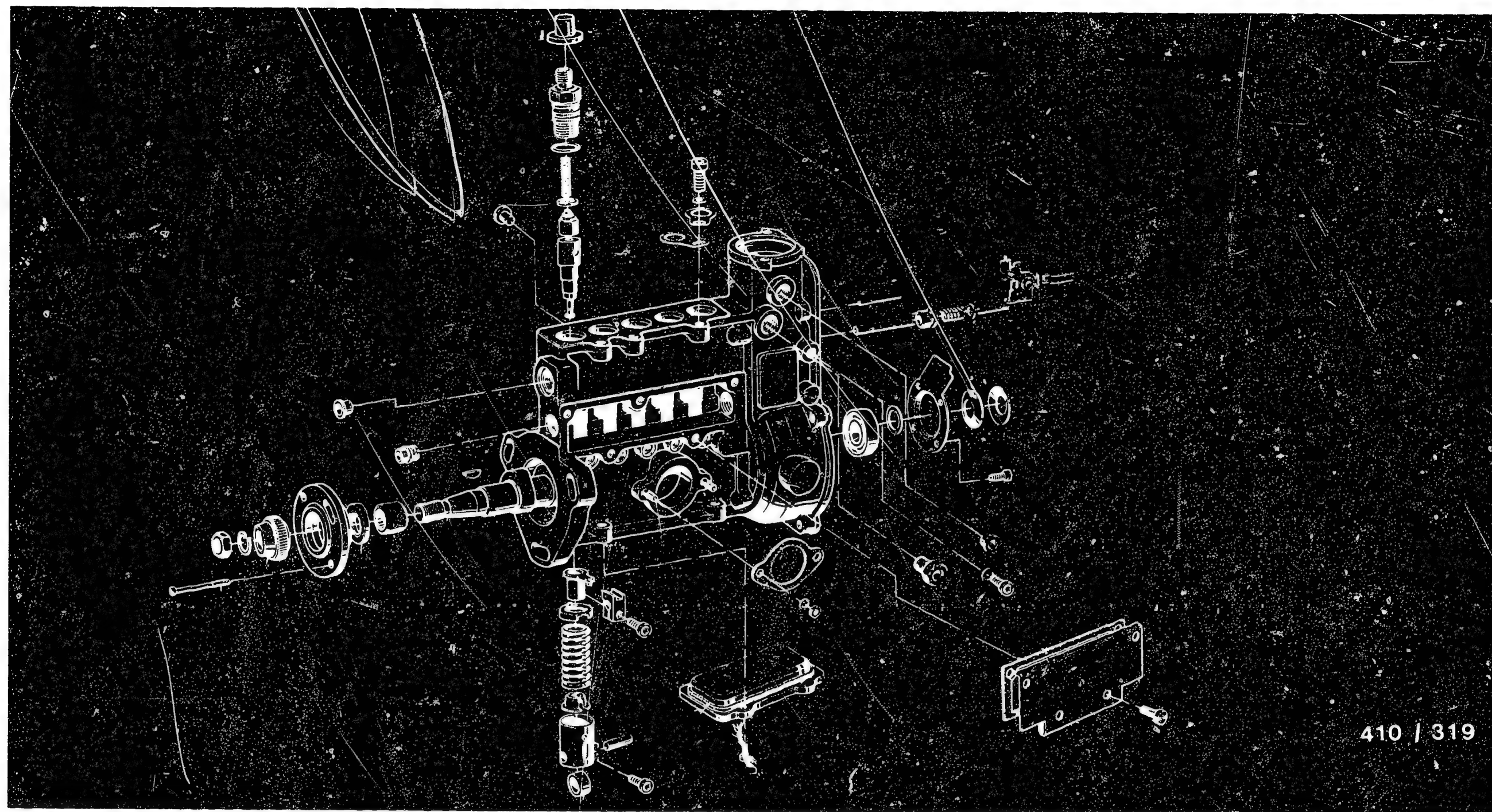


Description	Part number	Application
Mandrel	KDEP 1585	removal and installation of base plugs
Tool board	KDAW-T 100	pulling off ball-bearing outer races on bearing end plates

4.1 Lubricants

Special gear grease (Ft 1v27)	50g tube	5 700 052 005
	250g tube	5 700 052 025
Hylomar sealant (VS 9844-KK)	25g tube	5 927 350 002
Sealing varnish, yellow (Kk 26v9)	30g tube	5 703 245 003
High melting-point grease (Ft 1v4)	250g tube	5 700 002 025
Lubricating oil (VS 13834 OL)	0.5 l can	5 962 260 605





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5. Exploded view

M-pump without FBG system

A18

Exploded view

PES..M.., 0 410..

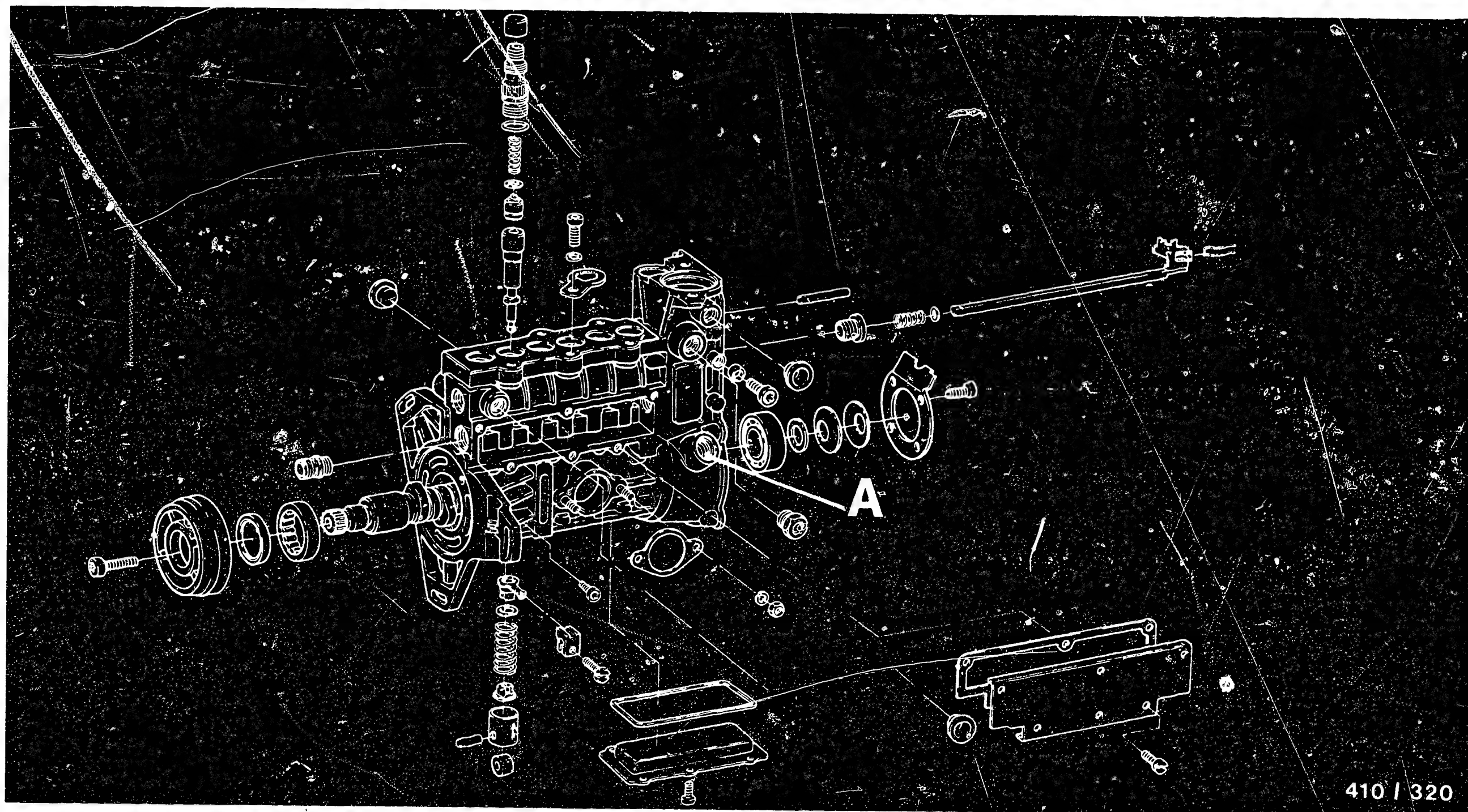


A19

Exploded view

PES..M.., 0 410..





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Exploded view of M-pump with FBG system

Special features:

Mounting hole for pulse generator or mounting bracket in pump housing (A)

Camshaft with serration (DB version)

A20

Exploded view

PES..M..., 0 410..



A21

Exploded view

PES..M..., 0 410..



6. Trouble-shooting chart for section "partial repair"

If there is no customer complaint or symptom of trouble, it is recommended that an initial check be carried out on the test stand.

6.1 Customer complaint (symptom of trouble)

- 1. Control rod sticks
- 2. Engine fails to shut off or does so only hesitantly
- 3. Cold engine fails to start or starts with difficulty
- 4. Bucking with M/RSF I pumps
- 5. Transverse engine shaking and idle
- 6. Pre-chamber/sheathed element glow plugs defective

<u>Cause of trouble</u>						<u>Coordinates</u>
•					Check position of control sleeves	B 3
•					Replace shutoff stop screw	B 4
•					Check short-circuit ring of control-rod-travel sensor for freedom of movement	B 5
	•				Vacuum unit (shutoff box) defective/sticks	B 6
		•			Check pneumatic idle increase	B 7
			•		Replace idle-speed auxiliary spring	B 8
				•	Check idle delivery dispersions	B 10
				•	Check prestroke at start of delivery	E 21

B1

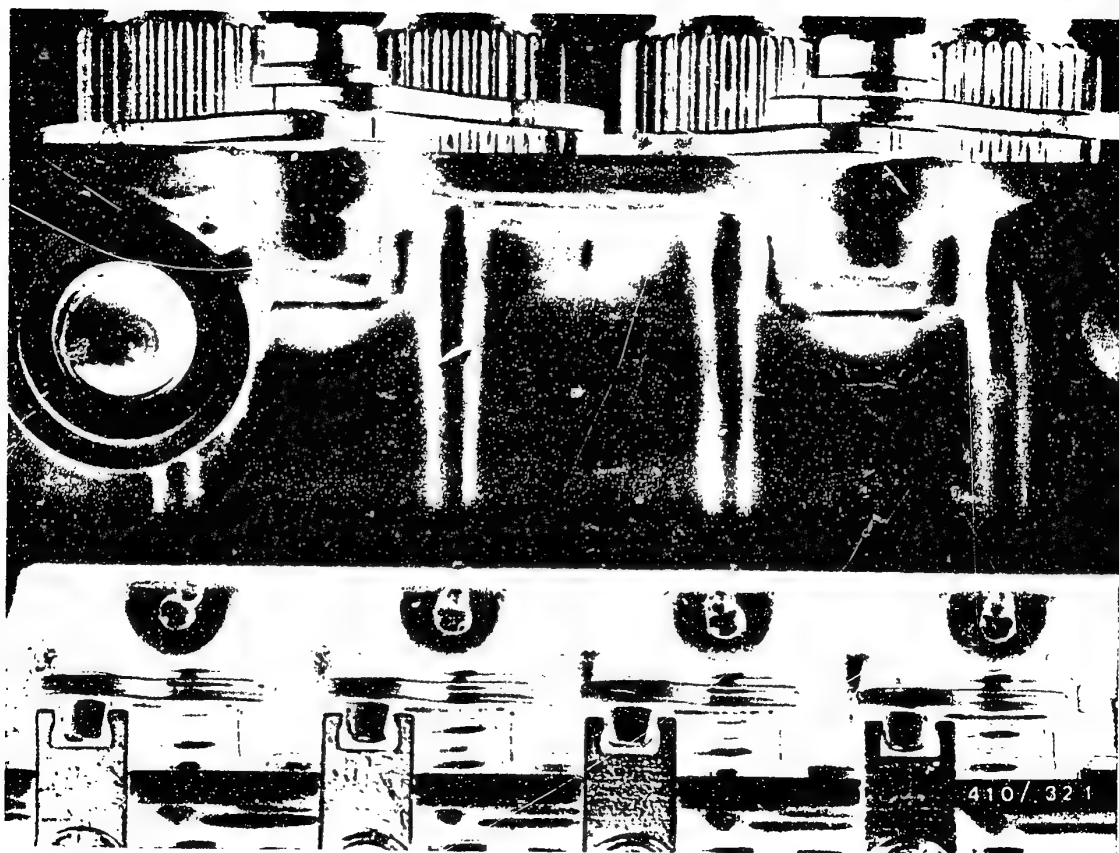
Trouble-shooting chart - partial repair
PES..M.., 0 410..



B2

Trouble-shooting chart - partial repair
PES..M.., 0 410..





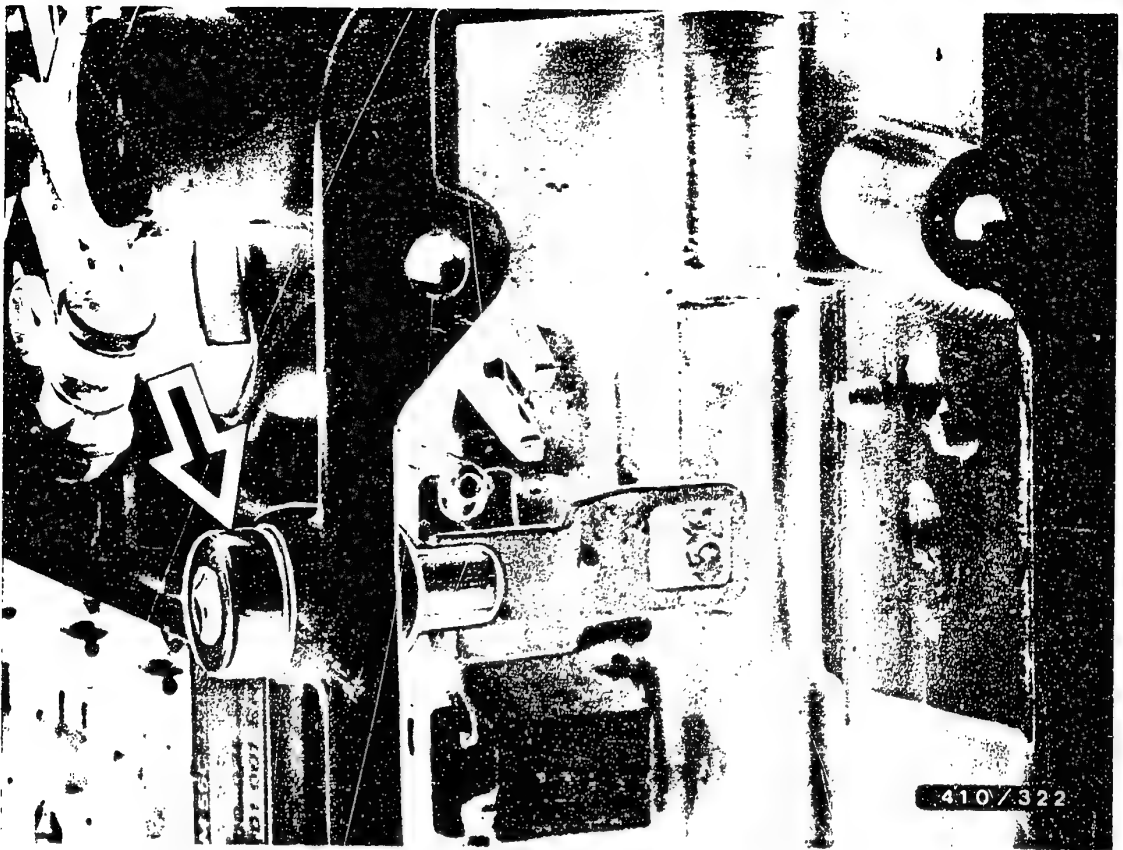
6.2 Partial repair

6 2.1 Check position of control sleeves

Remove spring-chamber cover.

Check control rod for freedom of movement and equal left/right stop. In addition, make sure that when the control rod is at the "start/stop" position, the linkage levers do not become unhinged or graze against the upper spring seats or plunger return springs.





Arrow = Shutoff stop screw

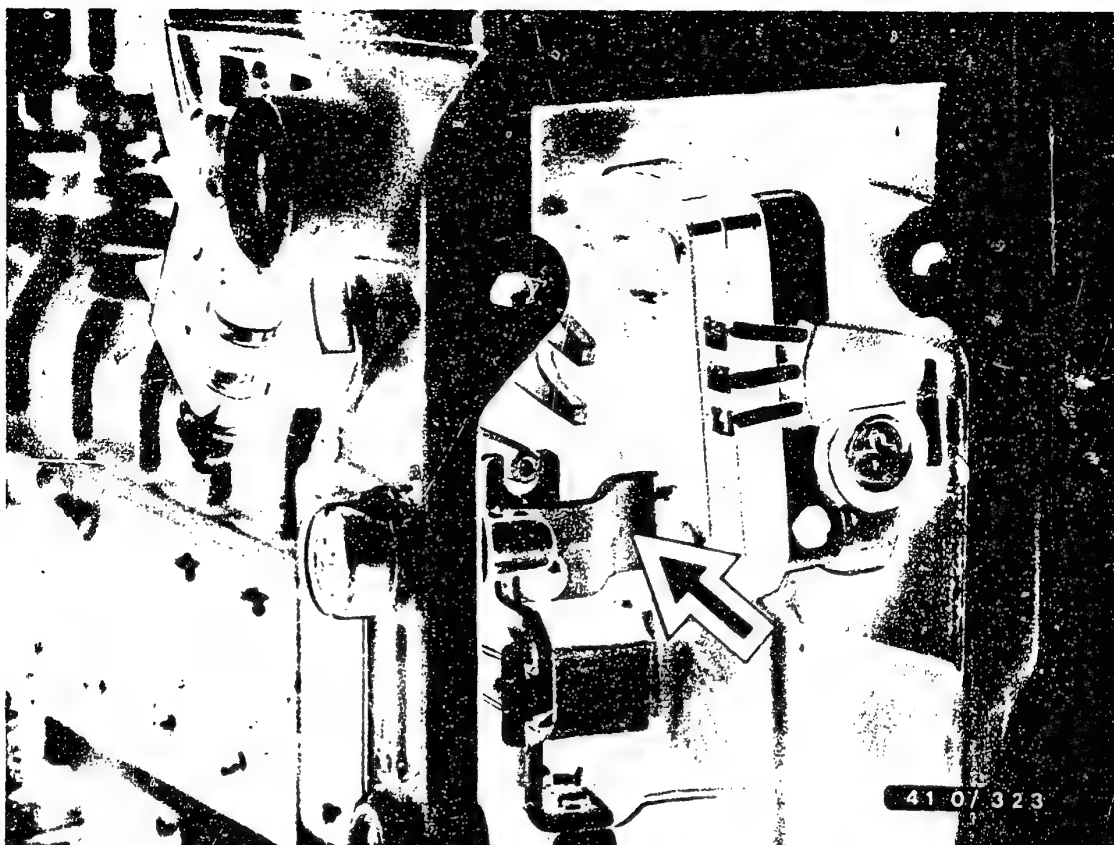
6.2.2 Replacing shutoff stop screw

Starting with FD (date of manufacture) 449, a new shutoff stop screw with larger pin diameter is installed.

Exchanging the shutoff stop screw prior to FD 449 without resetting pump

- Remove old shutoff stop screw
- Screw in new shutoff stop screw 1 413 414 010.
Code: white chromating instead of yellow.





Arrow = Short circuit ring

6.2.3 Checking short circuit ring for freedom of movement

On pumps with control-rod-travel sensor (RWG), check the short circuit ring (component part of control rod) for freedom of movement.

Remove governor per repair instructions. Within the range of adjustment (control-rod travel 0-21 mm), short circuit ring should slide along the longitudinal leg of the control-rod-travel sensor without touching.

Note:

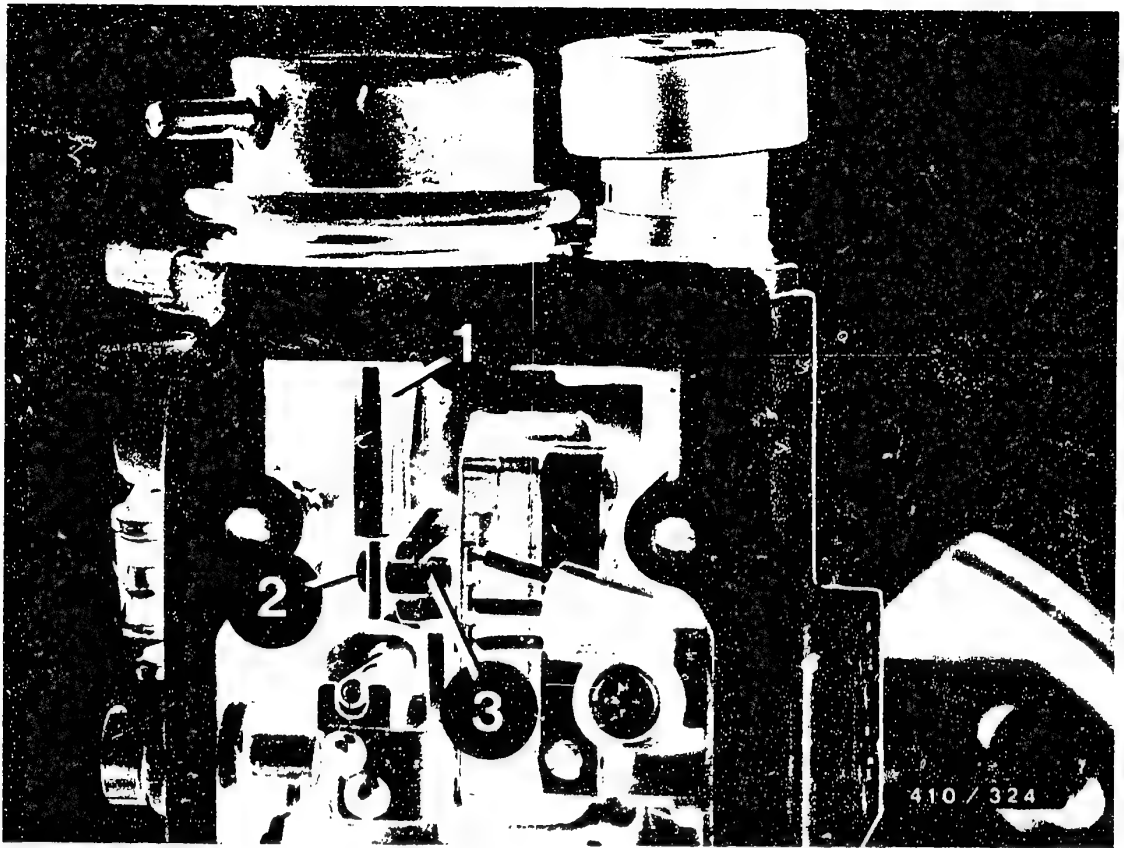
Take note of tilt play of control rod.

B5

Partial repair

PES..M., 0 410 ..





1 = Guide rails
2 = Rivet head

3 = Driver

6.2.4 Checking vacuum unit

If the vacuum unit is defective, the cause can be a defective shutoff box with unequally-bent guide rails or with an excessively large rivet head.

Mechanical test:

Exert lateral force on driver. Connecting rod must still slide easily in the guide rail.

Leak test:

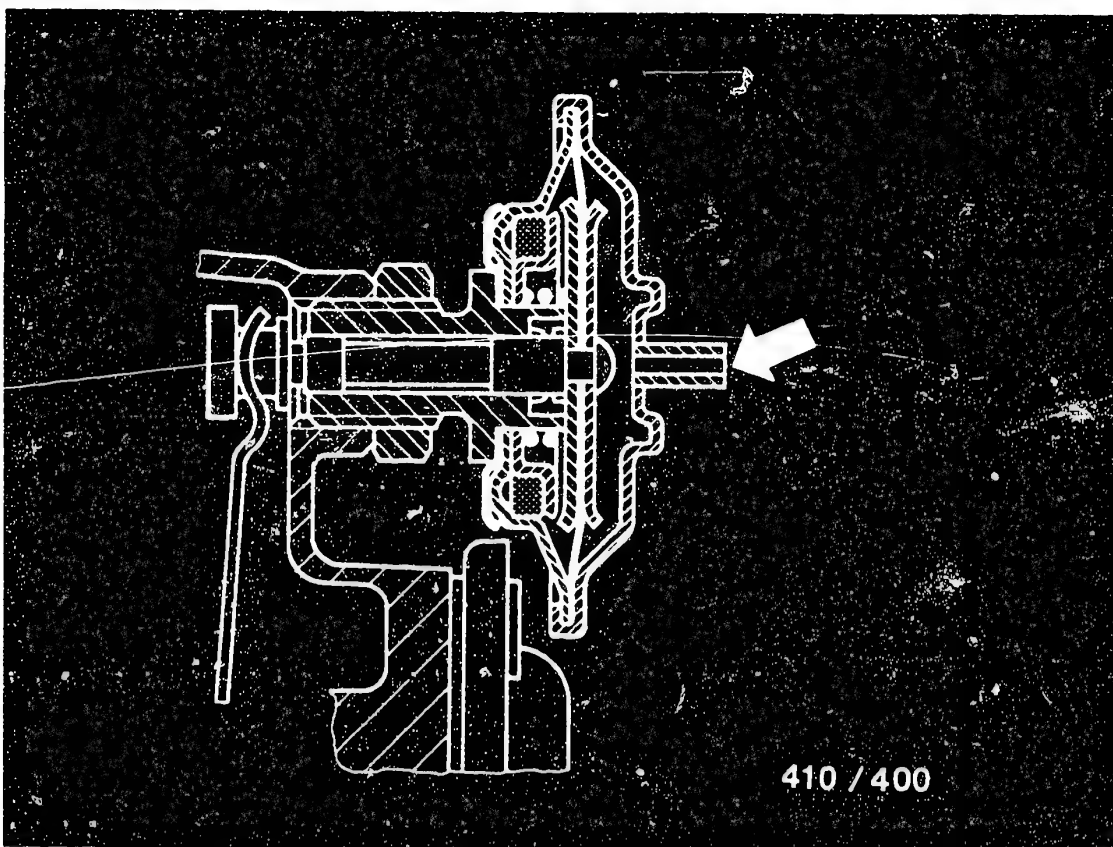
Apply 0.5 bar vacuum to vacuum unit. Control rod must be pulled to shutoff stop.

B6

Partial repair

PES..M., 0 410 ..





6.2.5 Checking pneumatic idle increase

Apply 0.8 bar vacuum to pneumatic idle increase unit at vacuum connection (arrow).

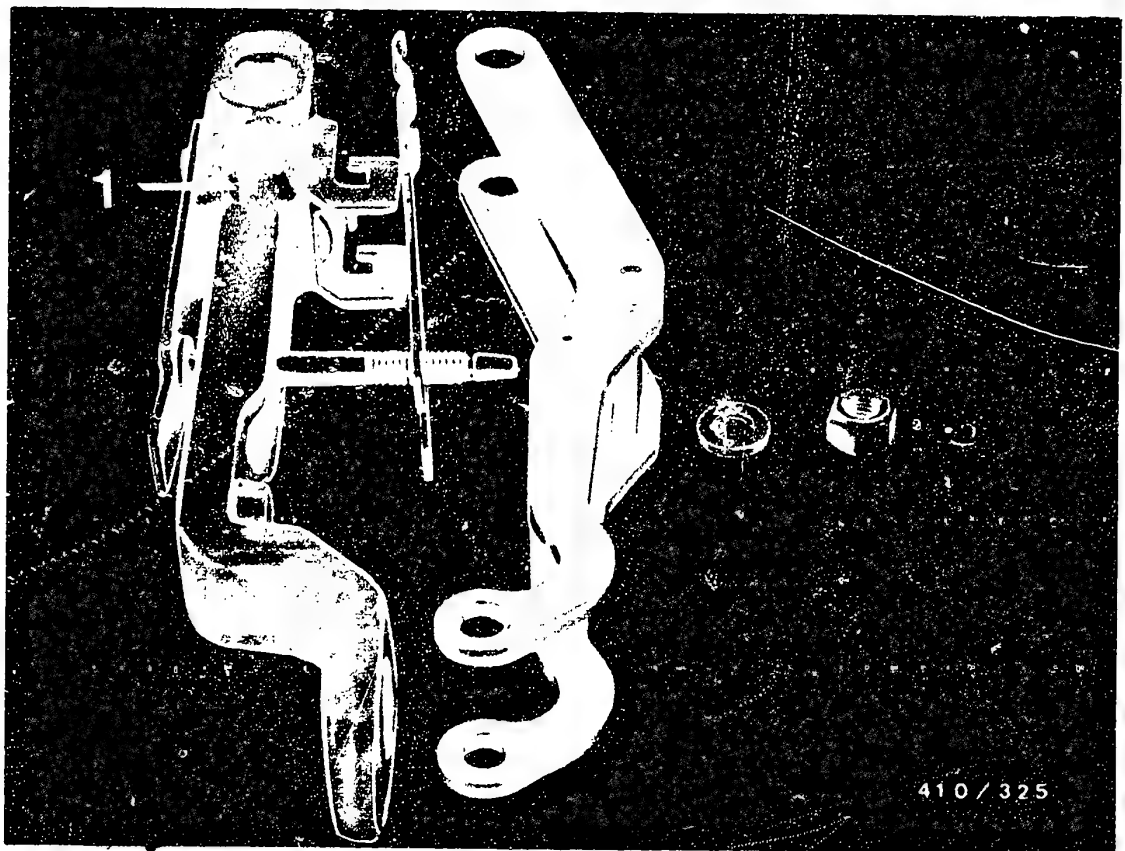
Permissible pressure drop 30 mbar within 15 sec.

B7

Partial repair

PES..M.., 0 410 ..





1 = Tensioning lever

6.2.6 Replacing idle-speed auxiliary spring

An improvement can be effected by installing a stronger idle-speed auxiliary spring (2.0 instead of 1.5 mm). Method of procedure:

- Remove tensioning lever with bolted-on idle-speed auxiliary spring together with adjusting screw.
- Install new tensioning lever with stronger idle-speed auxiliary spring together with stronger adjusting screw.
- After conversion, mark injection pump with dot of red paint on governor housing (next to pneumatic shutoff box).



Adjusting on pump test bench

The installation of the stronger idle-speed auxiliary spring moves the engine speed for the

full-load timing point	from $n = 220 \text{ min}^{-1}$
	to $n = 2100 \text{ min}^{-1}$

and for the

idle control lever	from $n = 1000 \text{ min}^{-1}$
	to $n = 1100 \text{ min}^{-1}$

Note:

This obviates Adjustment point 5 in Section B of the test-specification sheet.



6.2.7 Checking idle delivery dispersions

Causes for customer complaints of transverse engine shaking in idle can be:

Injection-pump idle delivery dispersions and dispersions in engine.

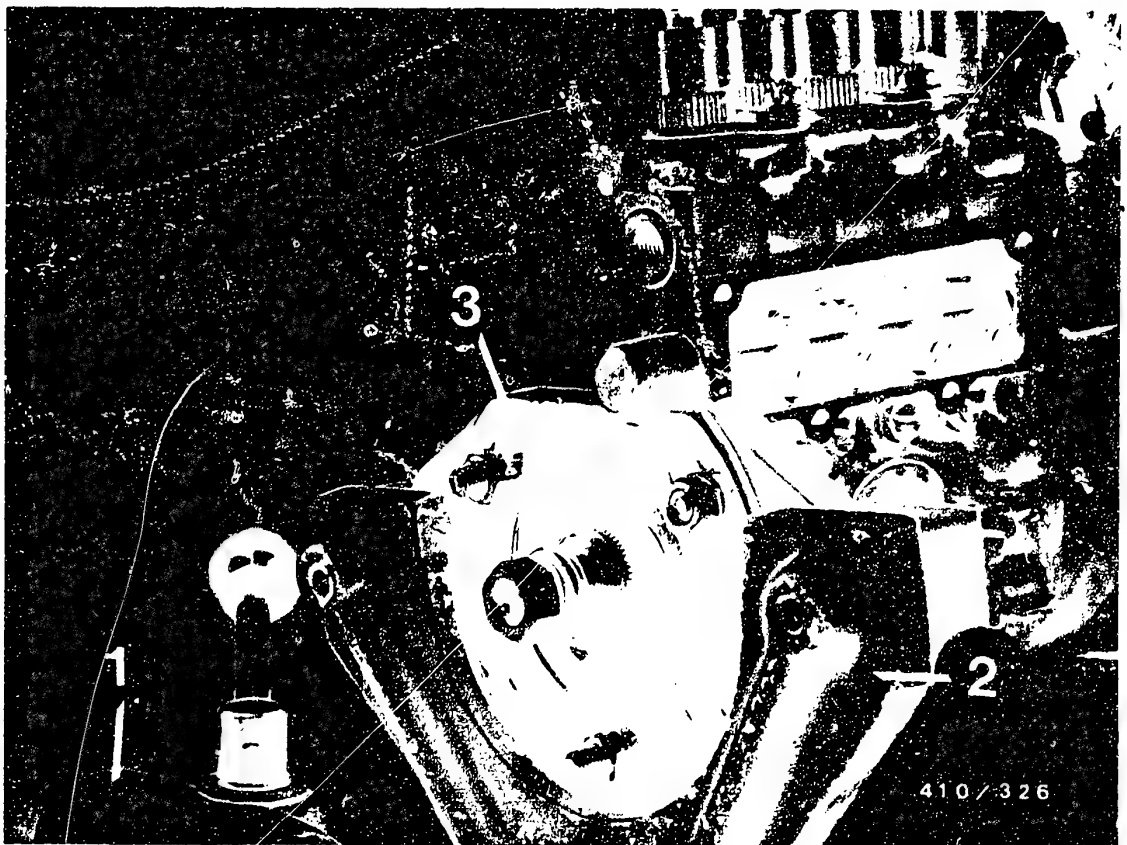
Transverse shaking can be remedied to an extent by reducing the idle delivery dispersion by $0.5 \text{ cm}^3/1000 \text{ stroke}$.

B 10

Partial repair

PES..M.., 0 410 ..



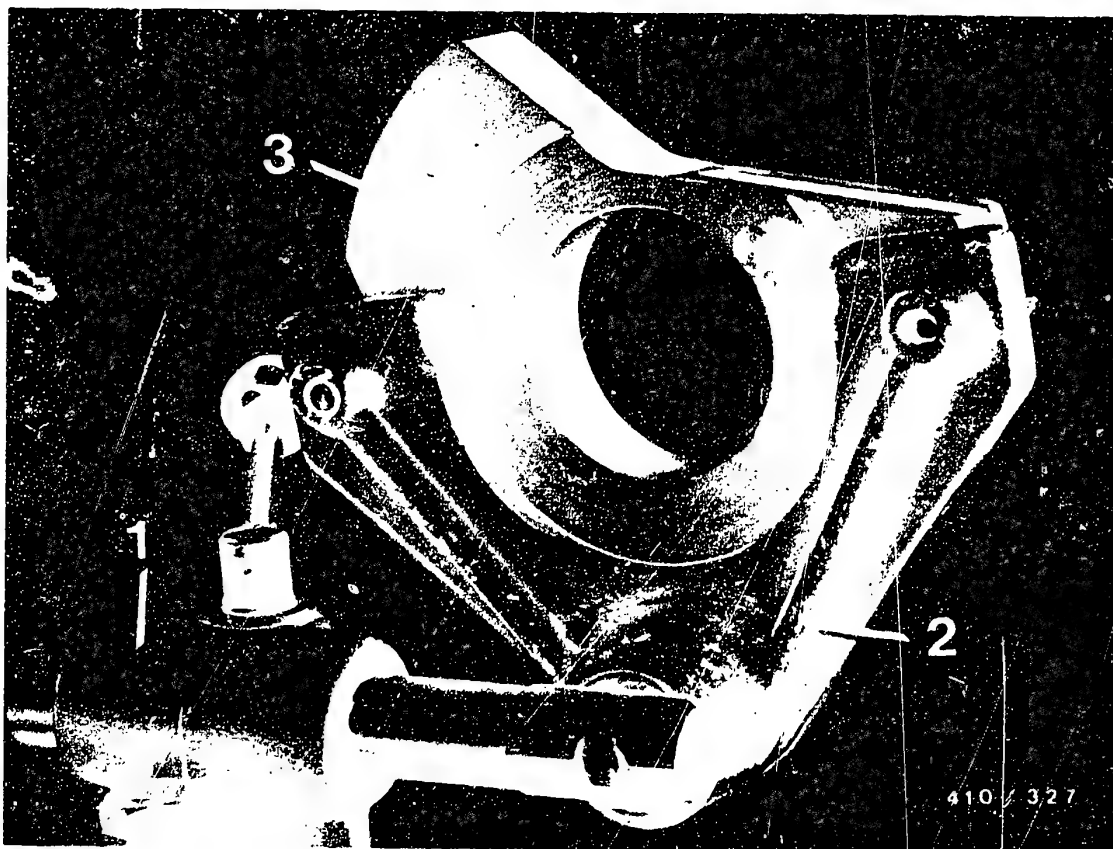


- 1 = Clamping support
- 2 = Support clamp
- 3 = Clamping flange appropriate for pump version

7. Clamping injection pump on assembly support

The clamping devices shown in the illustration are required to clamp injection pumps without FBG (start-of-delivery sensor) system.





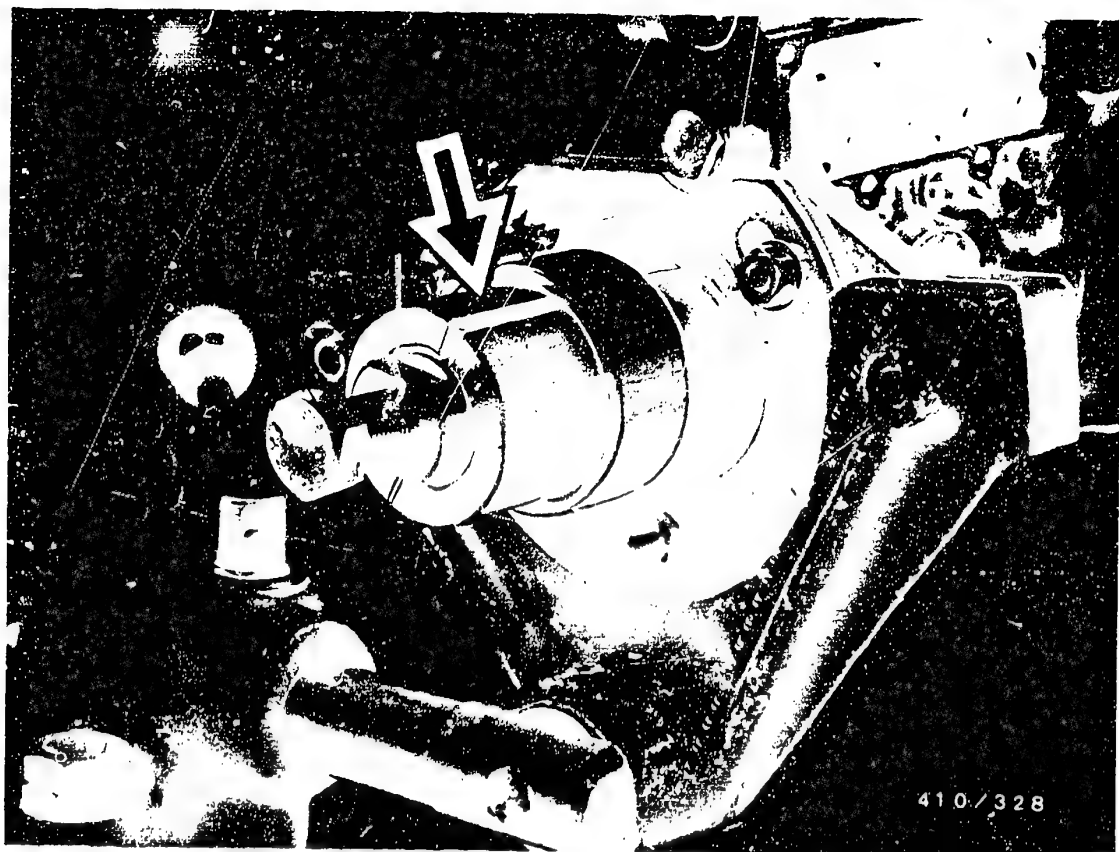
- 1 = Clamping support
- 2 = Support clamp
- 3 = Clamping flange

The parts shown in the illustration must be used for injection pumps with start-of-delivery sensor system.

B 12

Clamping injection pump
PES..M.., 0 410..

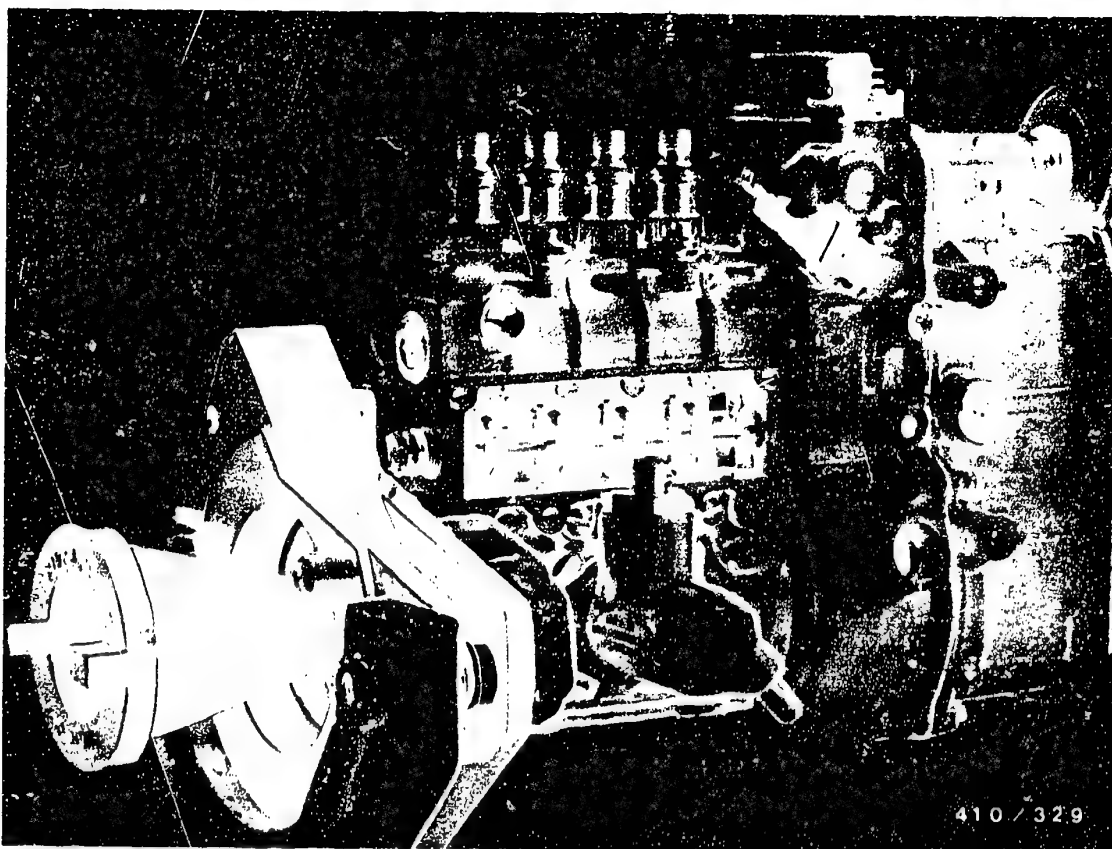




8. Disassembling injection pump

Remove mounted drive parts (toothed gear or timing device) with suitable commercially-available tools. Pull driver from cone of drive shaft with puller KDEP 1131 (arrow).





Push on drive coupling suitable for cone diameter of camshaft and tighten.

Note: Left-hand thread on pumps with FBG (illustration).

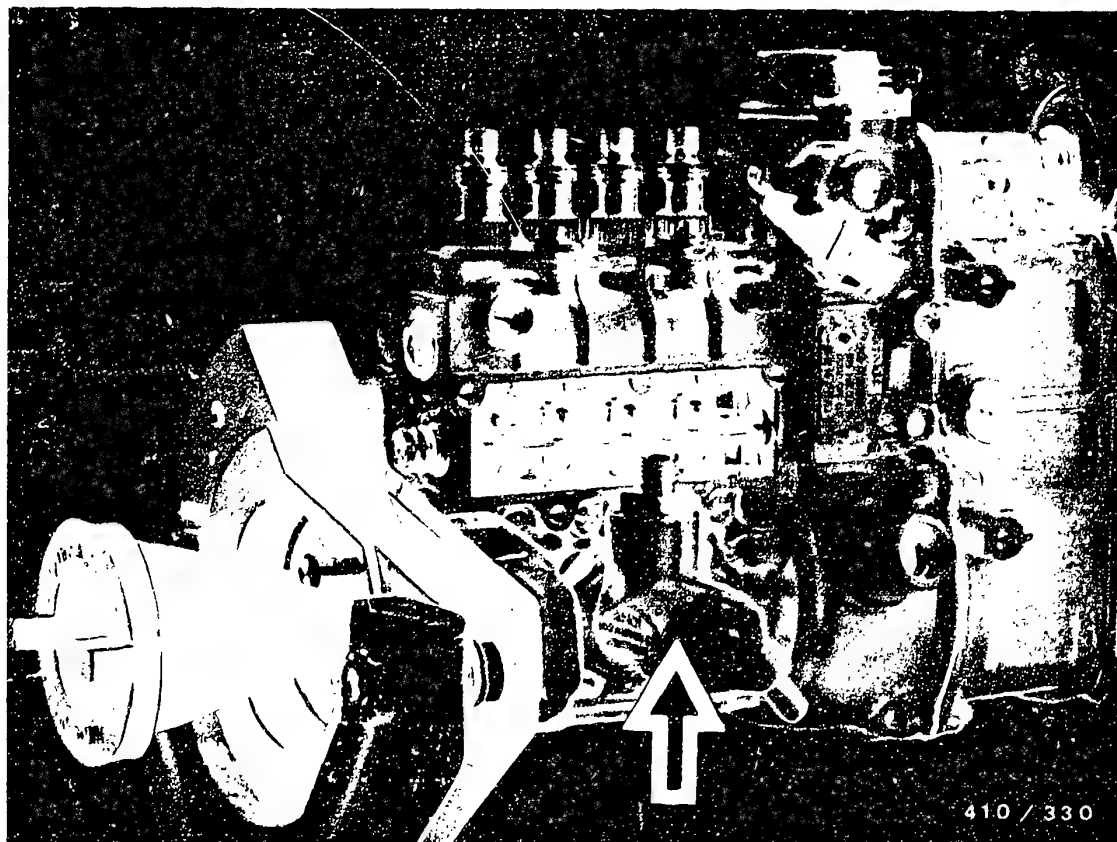
Disassemble governor per the type-specific repair instructions.

B14

Disassembling injection pump

PES..M..., 0 410..





Arrow = Supply pump

Remove supply pump and spring-chamber cover (already removed in illustration).

Note:

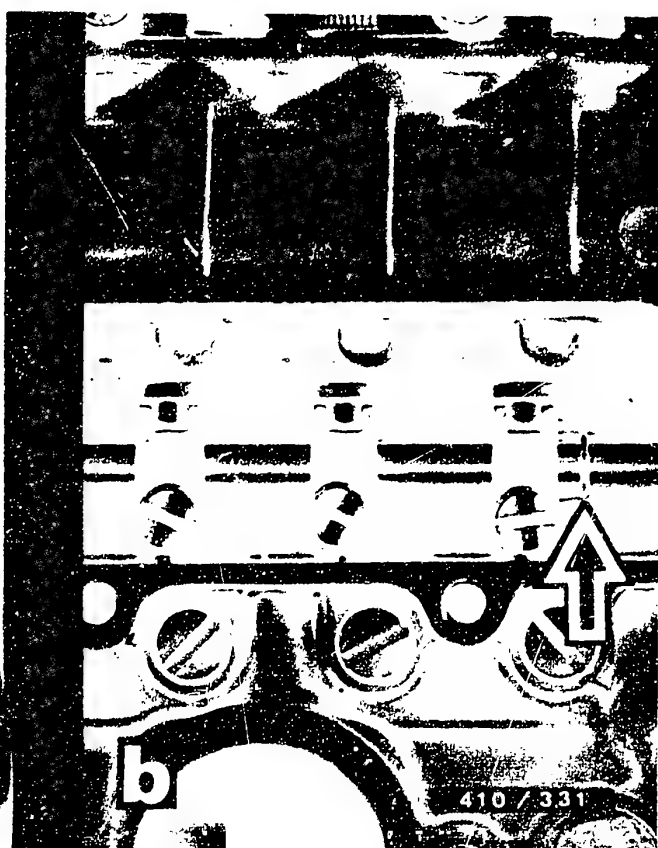
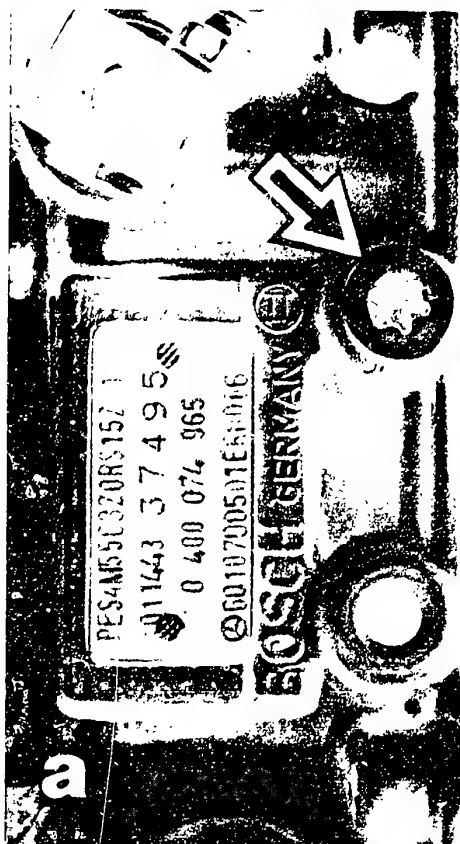
Have sufficient storage boxes on hand, appropriate for the size of the injection pump, to store individual parts during disassembly.

B 15

Disassembling injection pump

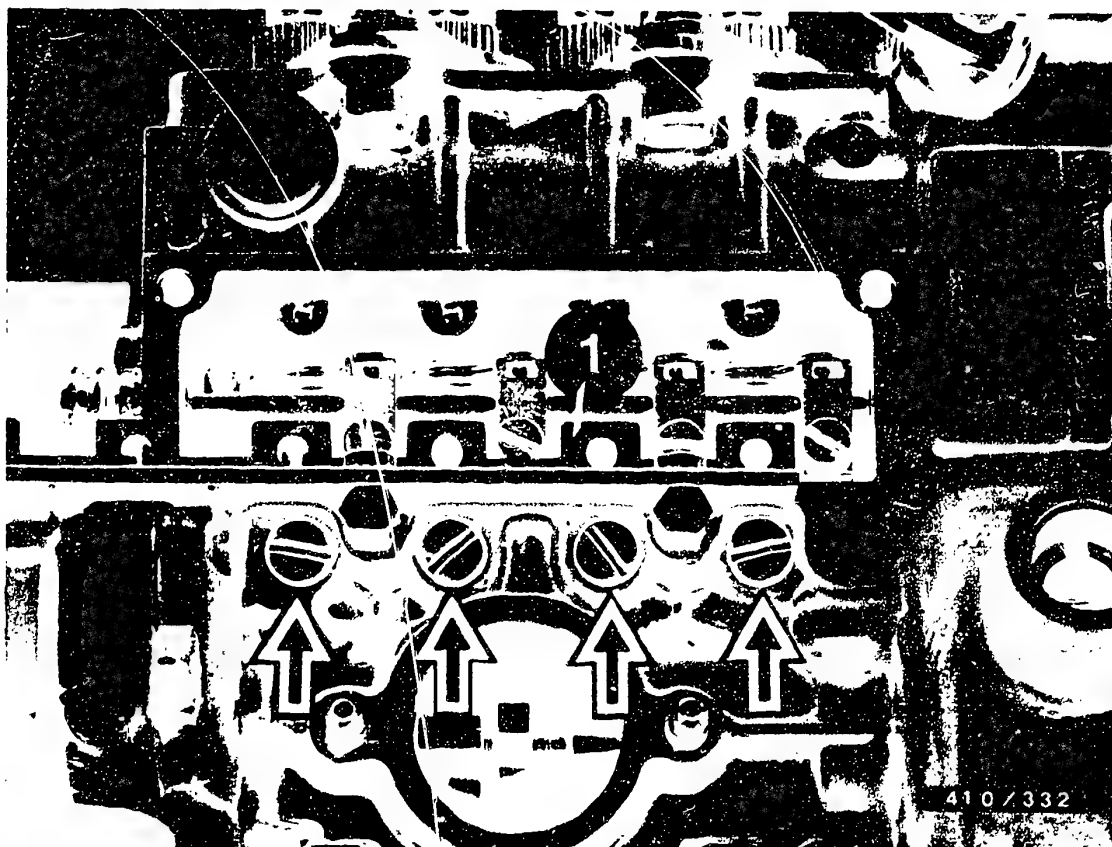
PES..M.., 0 410..





Remove control-rod shutoff-stop screw (fig. a, arrow).
 On pumps with pneumatic governor, remove retaining
 ring on control rod (fig. b, arrow).





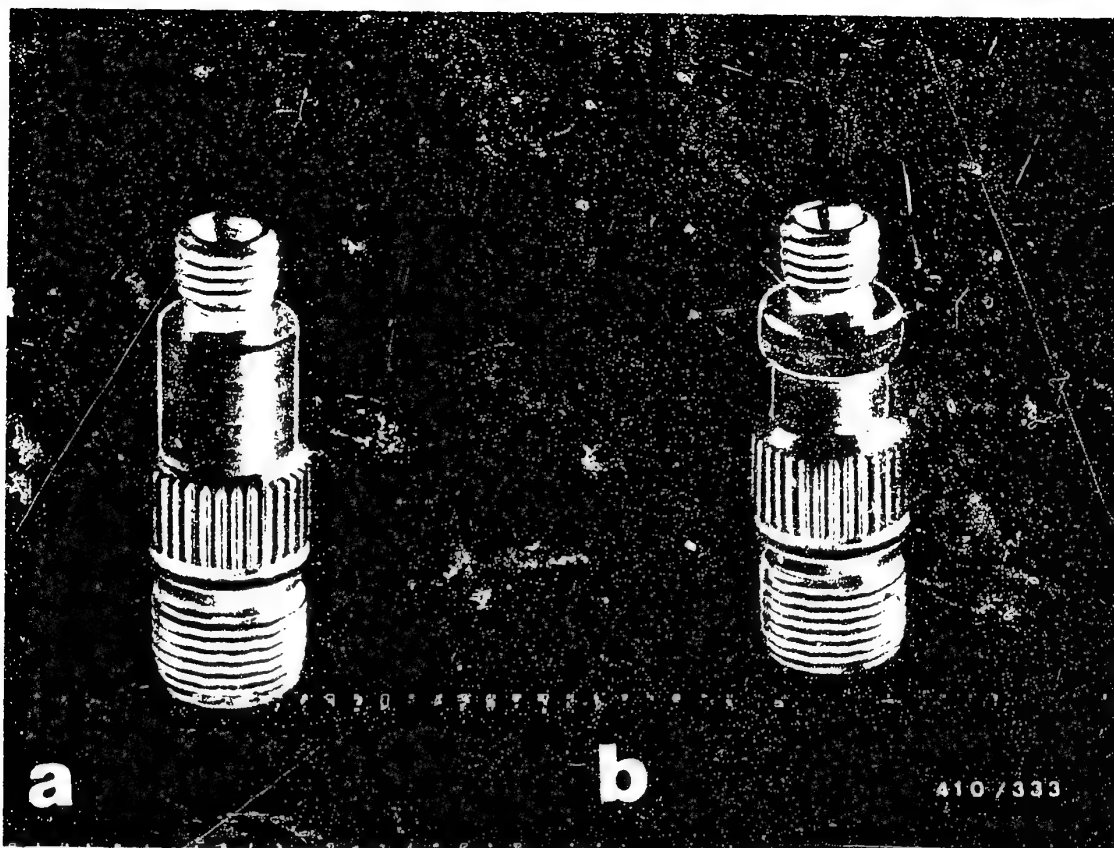
1 = Tappet holding device

8.1 Mounting tappet holding device

Insert tappet holding device KDEP 1563 appropriate for pump version into the threaded holes of the spring-chamber cover.

Only loosen, do not unscrew roller-tappet guide screws (arrows).



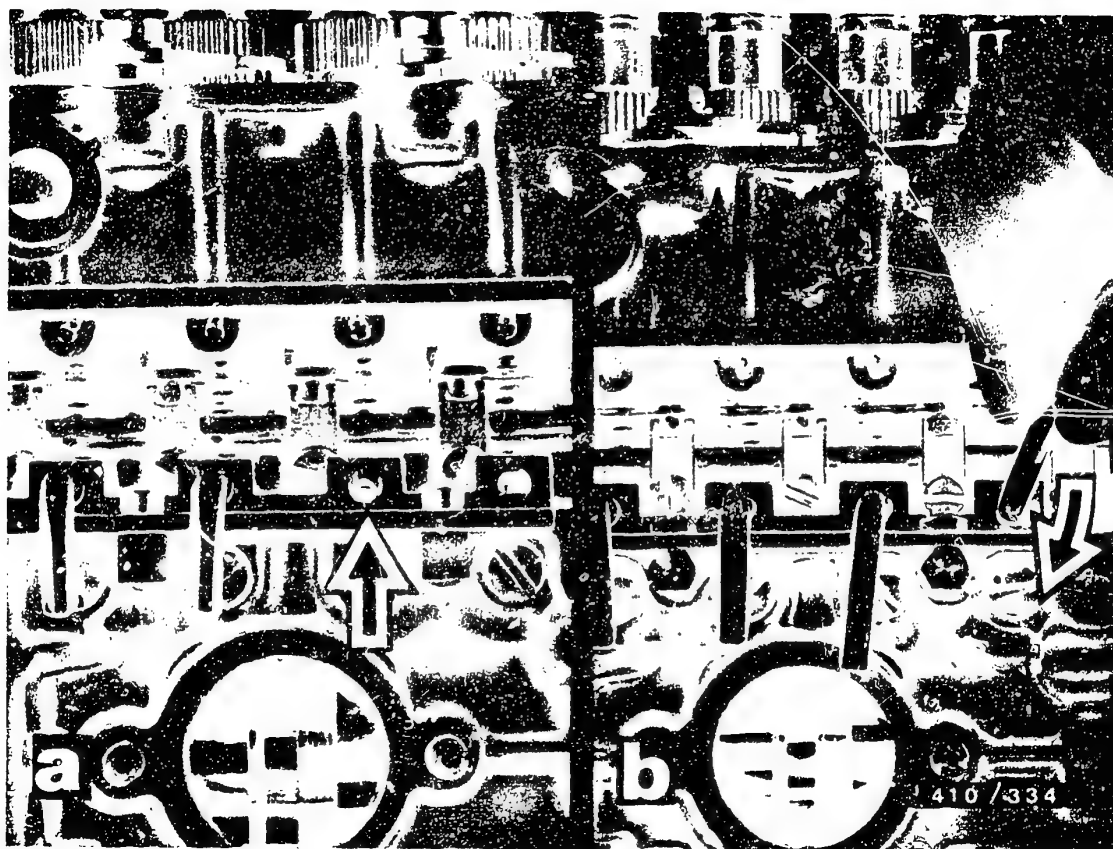


Inserting tappet holders

Use the tappet holders with greater outside diameter for pumps not having collars on the delivery-valve holders (fig. a).

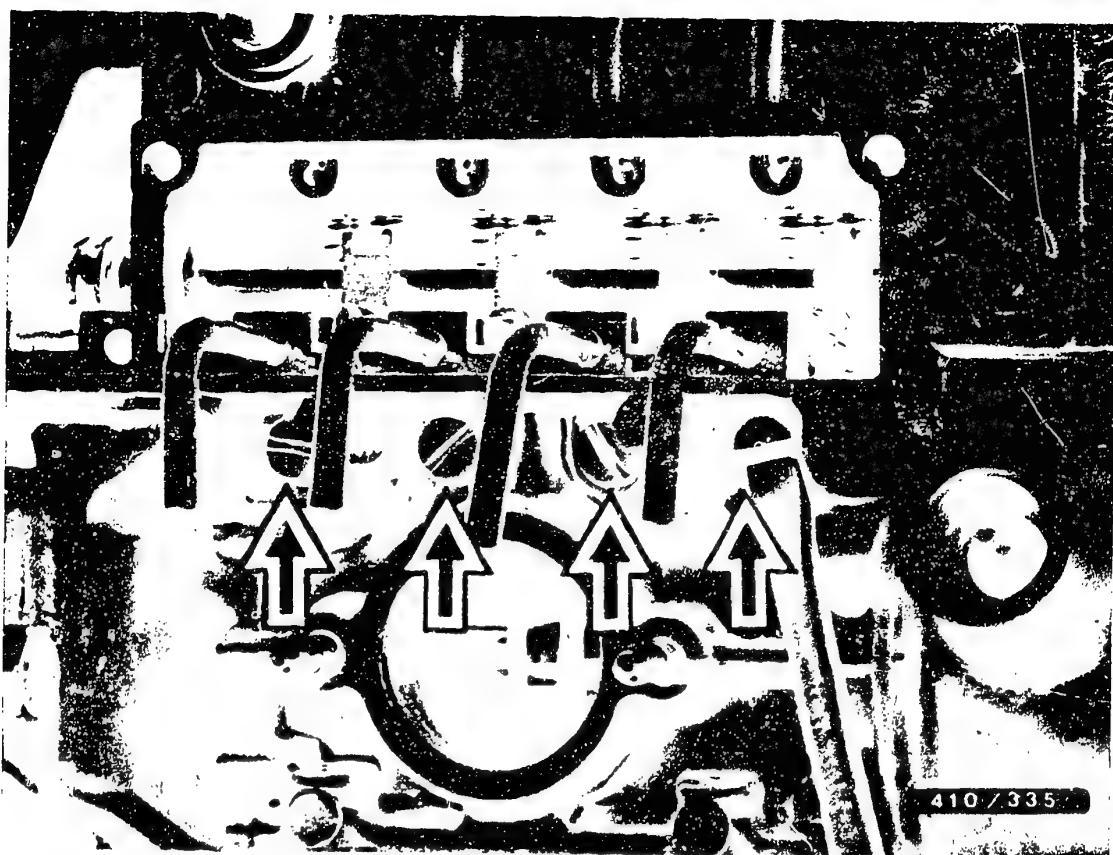
Use the tappet holders with smaller outside diameter for pumps with collar or hex nut (fig. b).





Turn camshaft with holding wrench and bring the individual roller tappets into TDC position (arrow). Insert tappet holder into borings so that the eccentric projection points downwards in the direction of the camshaft.

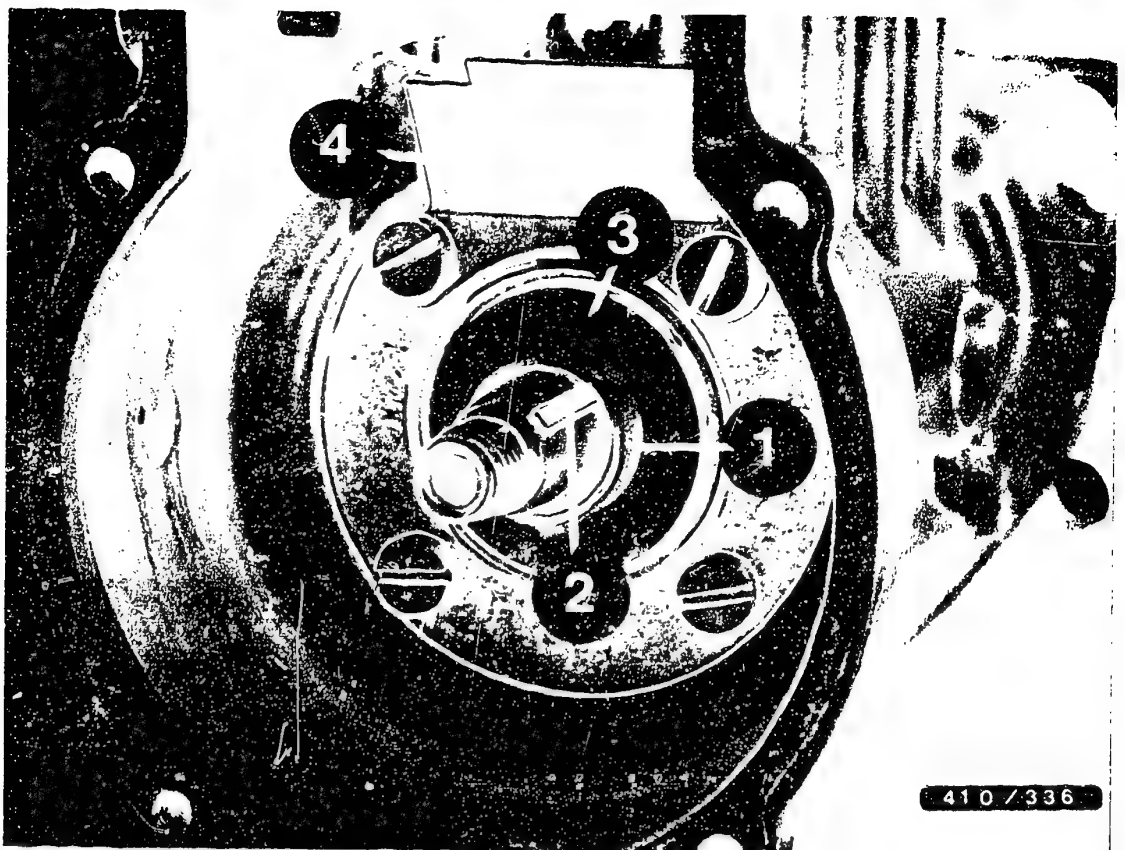
Turn tappet holder 180°. This causes the eccentric to lift the roller tappet from the cam of the camshaft.



Unscrew roller-tappet guide screws (arrows).
Remove drive coupling.

Swivel pump and remove base cover plate.





1 = Spacer sleeve
2 = Woodruff key

3 = Disk spring
4 = Supporting plate

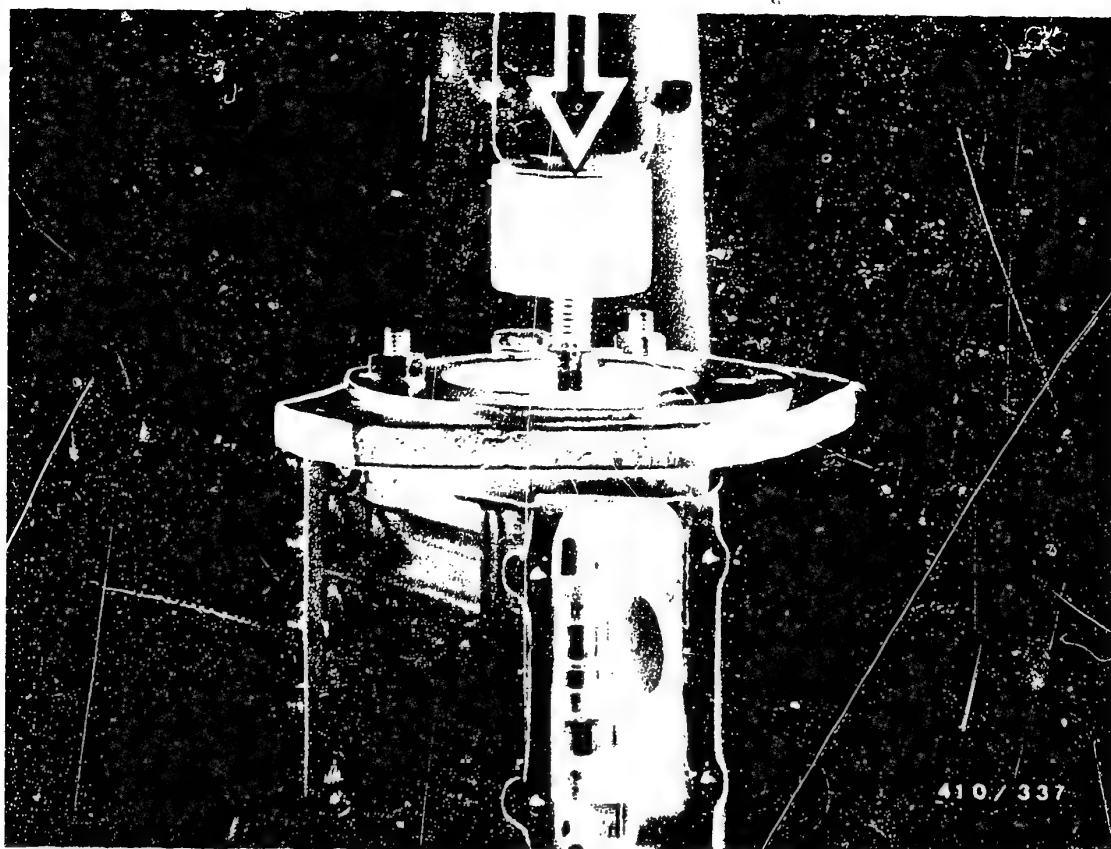
8.2 Preparations for removing camshaft

Remove spacer sleeve, Woodruff key, disk spring, and holding plate behind disk spring.
Remove supporting plate.

Note:

Pumps with FBG system have no Woodruff key.



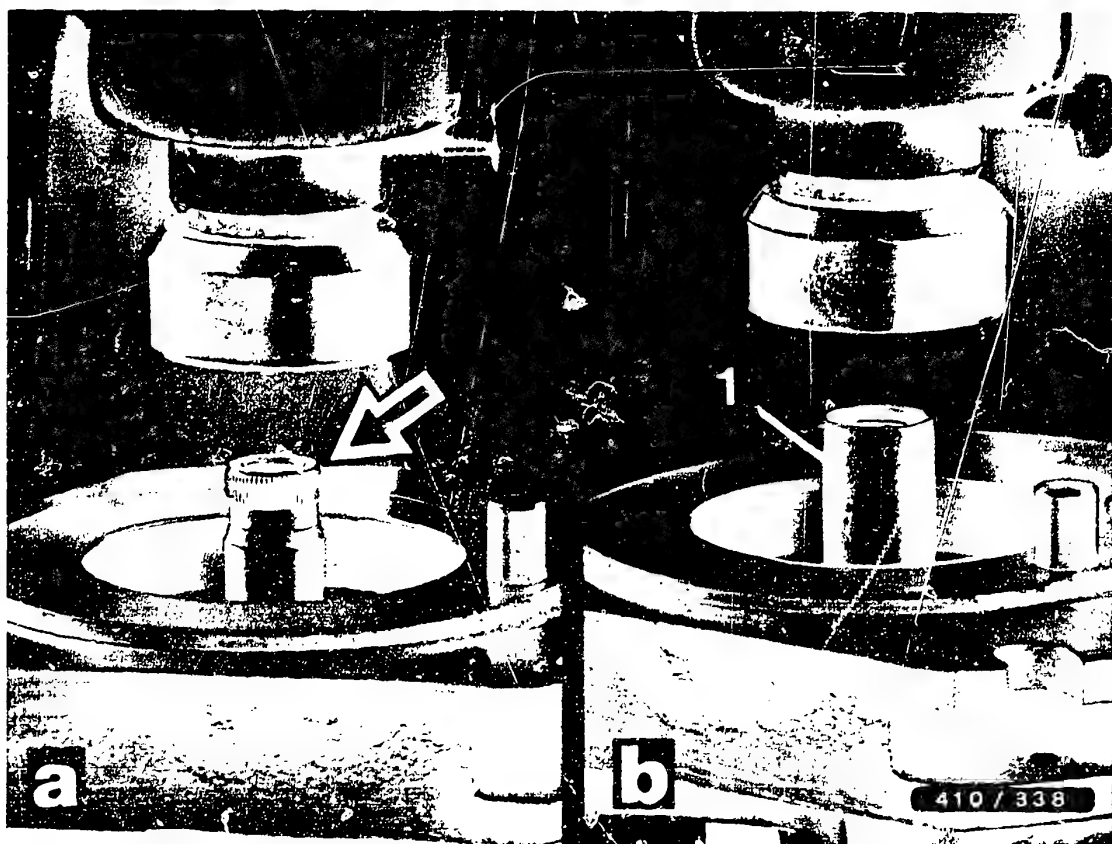


8.3 Removing camshaft

Dismount injection pump from clamping support and press out camshaft in the direction of the governor with an arbor press.

Remove injection pump from arbor press and remount in clamping support KDEP 2919.





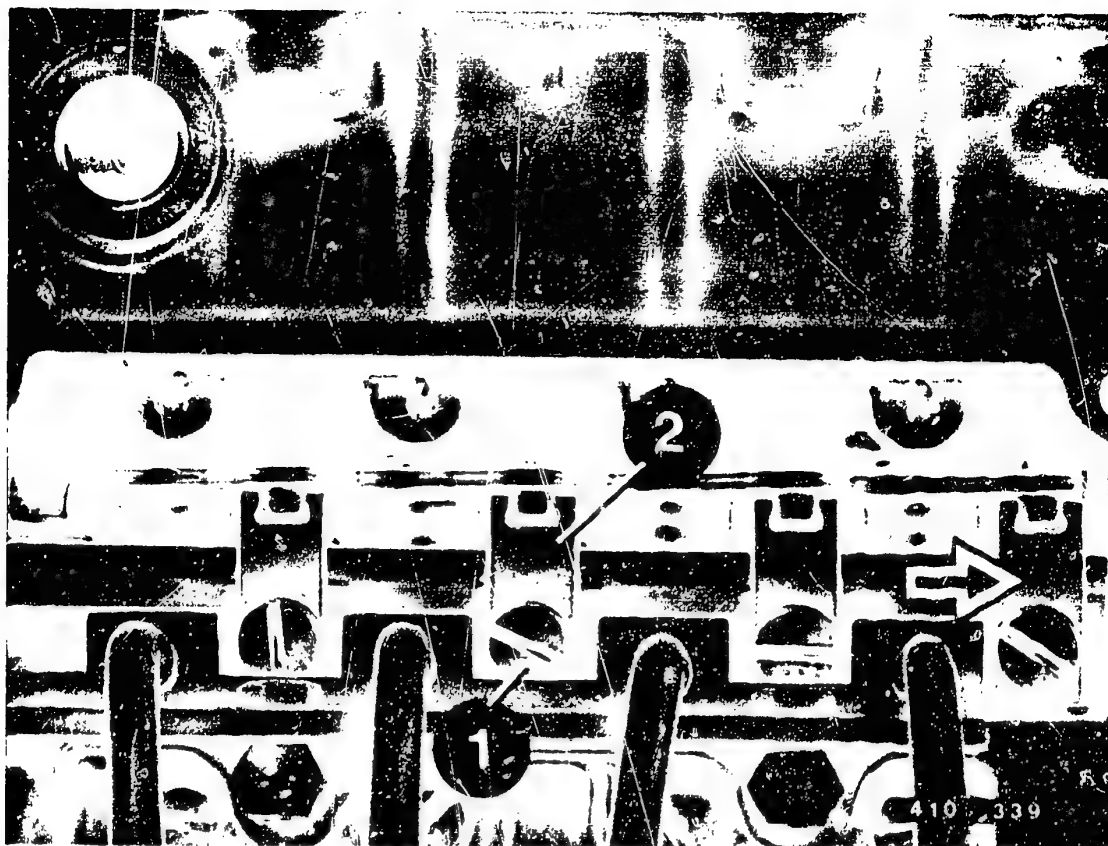
1 = Press-out sleeve

8.4 Removing camshaft (pump with FBG)

Remove injection pump from clamping support. To protect the serration on the camshaft (arrow), cover with press-out sleeve KDEP 1588. Press out the camshaft in the direction of the governor with arbor press.

Remove injection pump from arbor press and reattach to clamping support KDEP 2919.





1 = Clamping screw

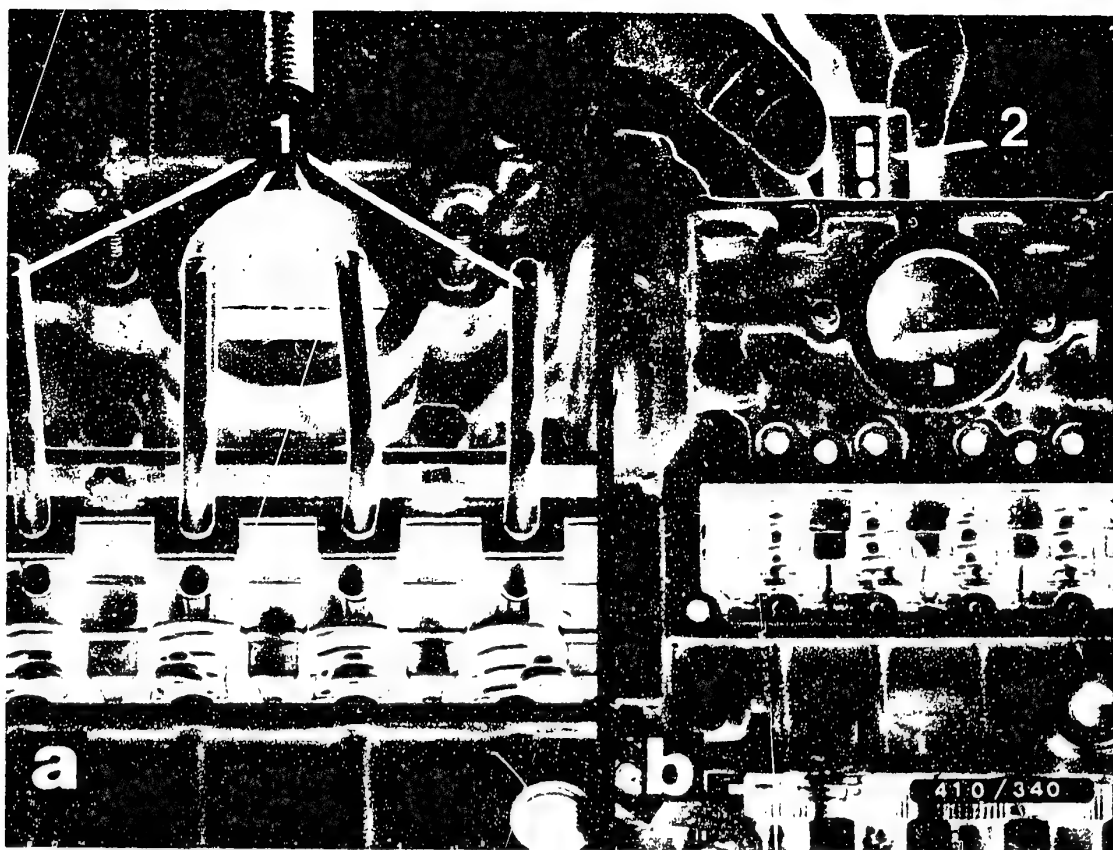
2 = Driver

8.5 Removing control rod

Loosen clamping screws on individual drivers and pull out control rod towards governor (arrow).

Remove drivers in sequence and deposit each in the appropriate storage compartment.





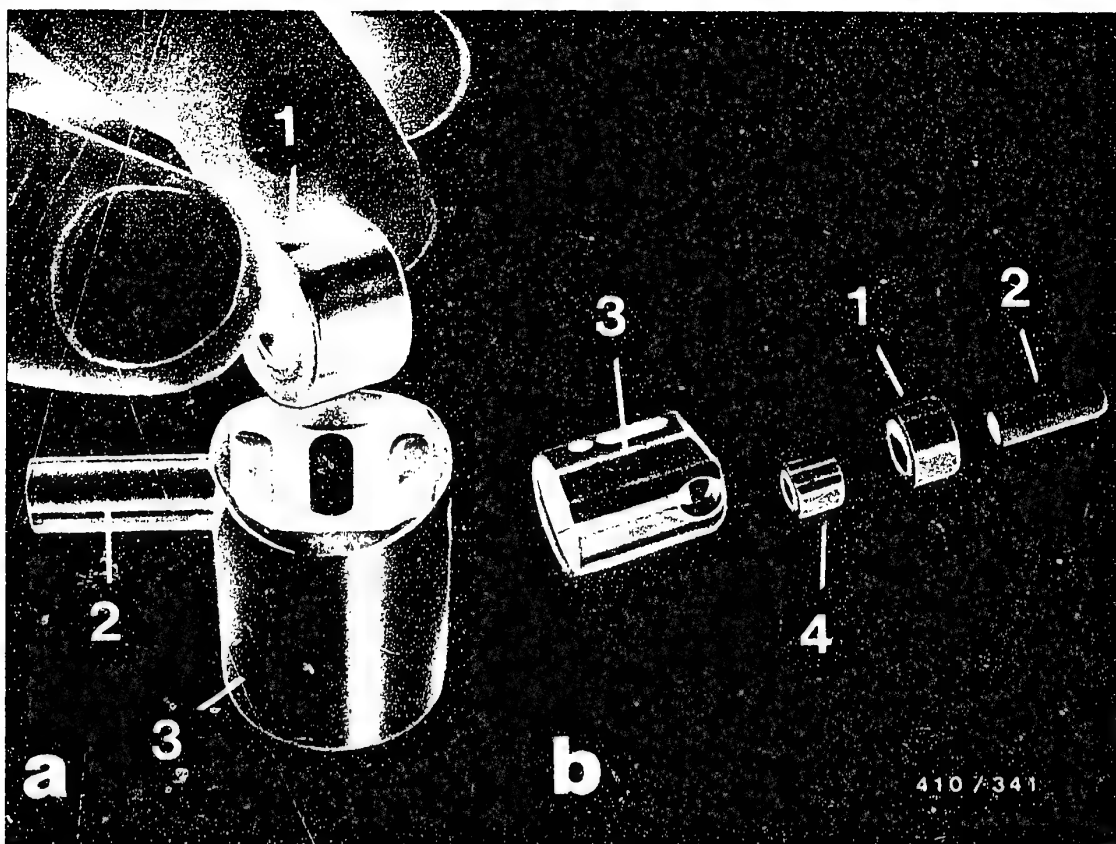
1 = Tappet holders

2 = Roller tappet

8.6 Removing roller tappets

Mount assembly device KDEP 1505 on pump. Position tappet of device on roller of roller tappet and press roller tappet down with lever. Remove tappet holder.

Remove roller tappet from pump housing.



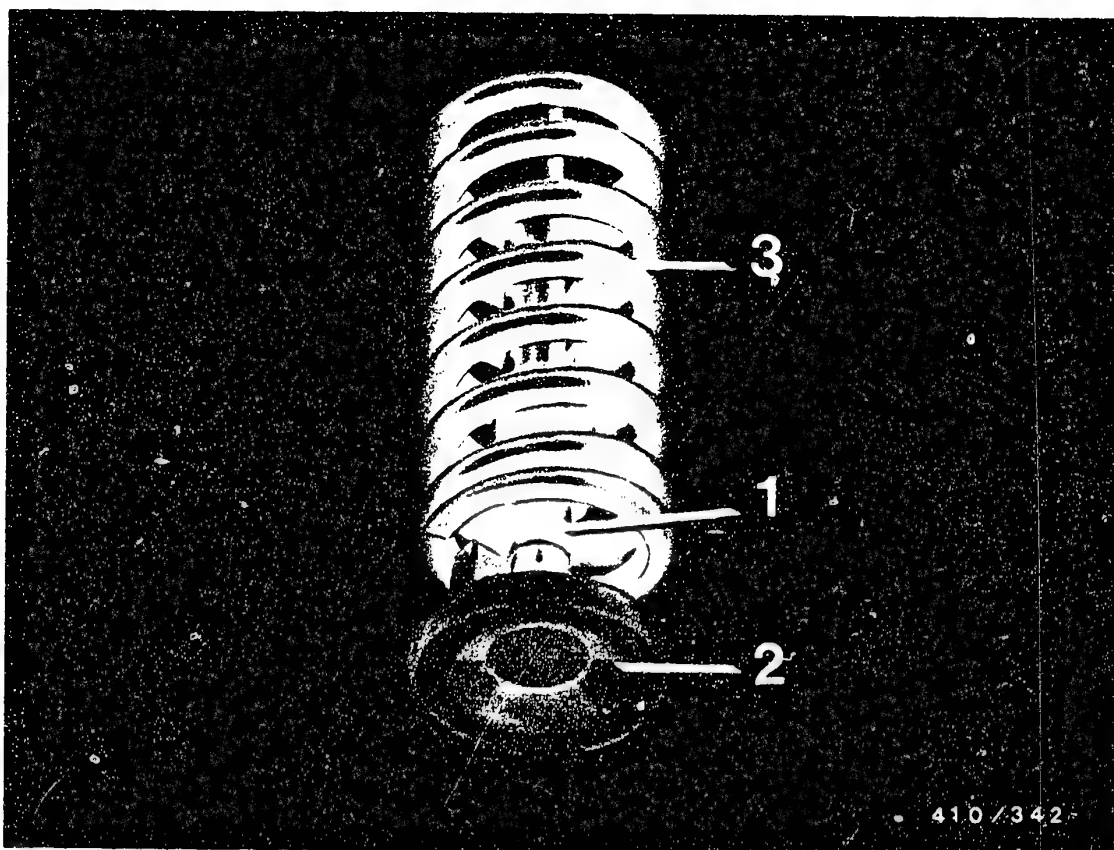
1 = Roller
2 = Bearing pin

3 = Roller-tappet shell
4 = Bushing

Deposit roller tappets in storage compartments.

Take care that bearing pins, rollers, and bushings (where present) do not get lost or mixed up with those of other roller tappets.





1 = Pump plunger
2 = Lower spring seat

3 = Plunger return spring

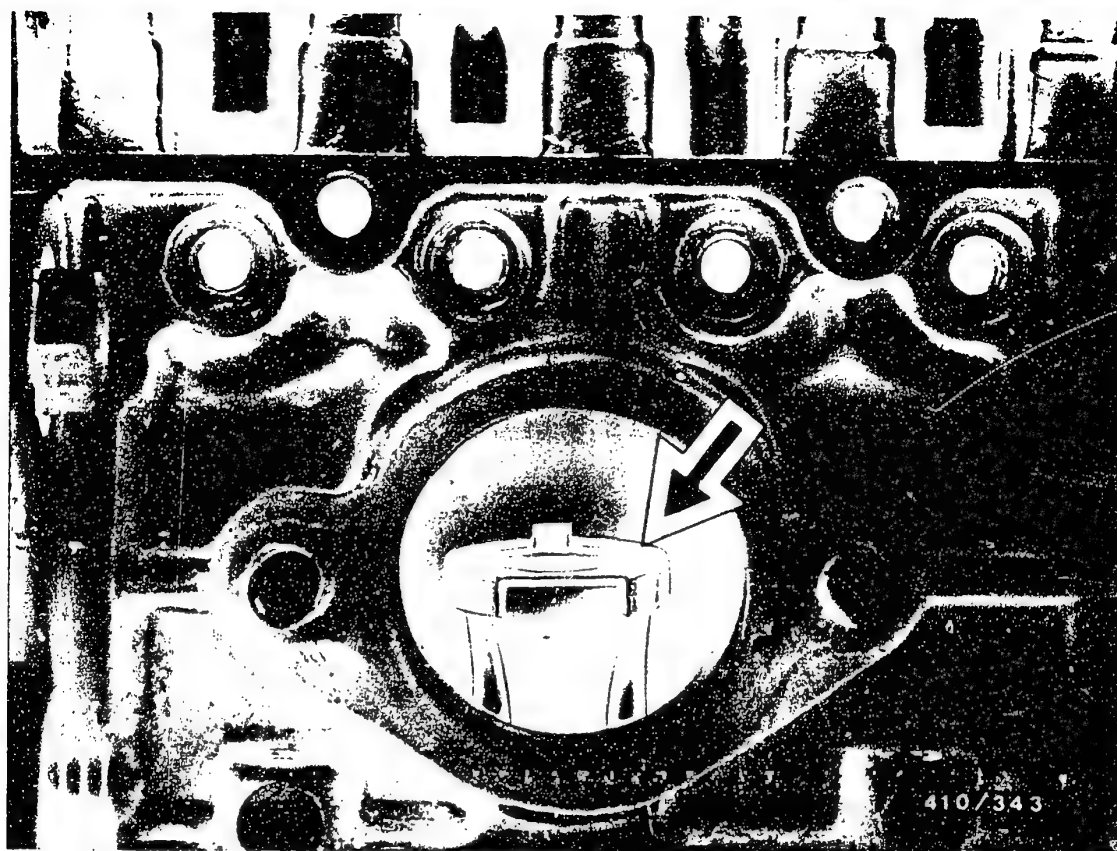
Remove pump plunger, lower spring seat, and plunger spring, and lay aside.

C3

Disassembling injection pump

PES..M.., 0 410..





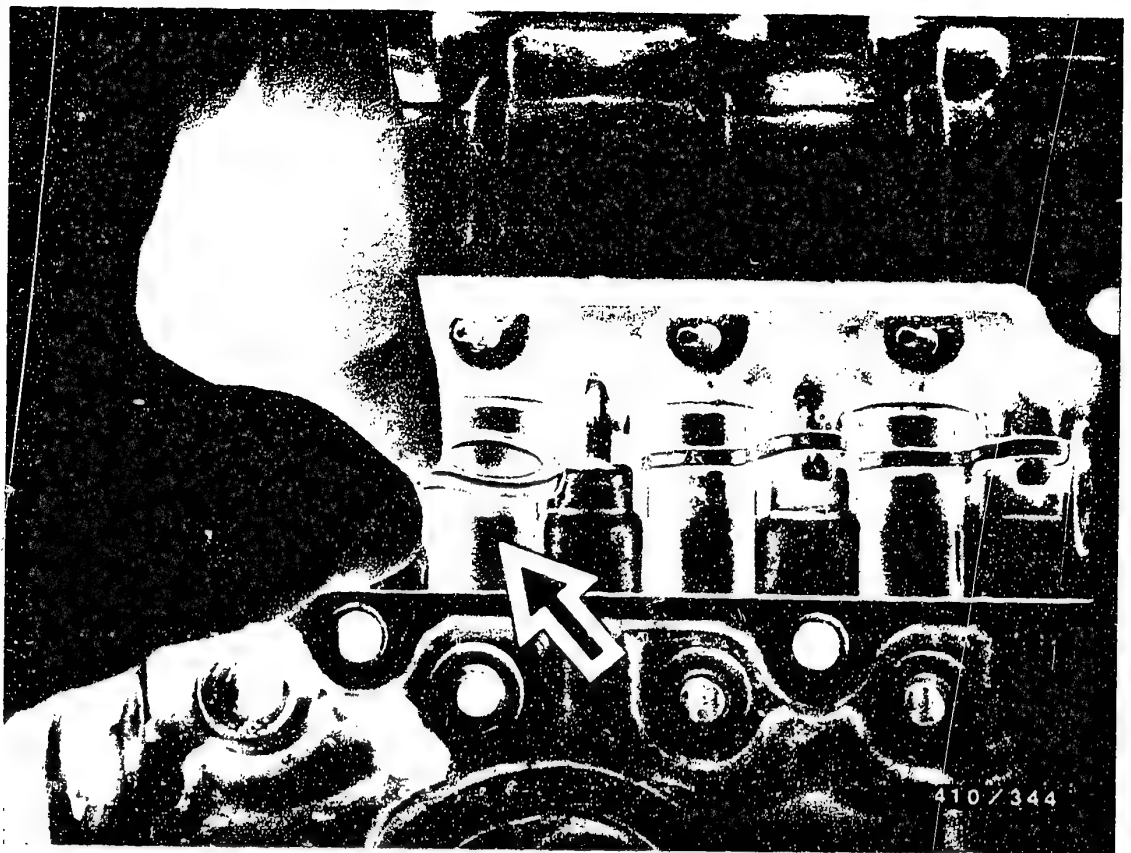
Arrow = Upper spring seat

Carefully remove upper spring seat from tappet guide without tilting, using pointed pliers.

C4

Disassembling injection pump
PES..M., 0 410..





Arrow = Control sleeve

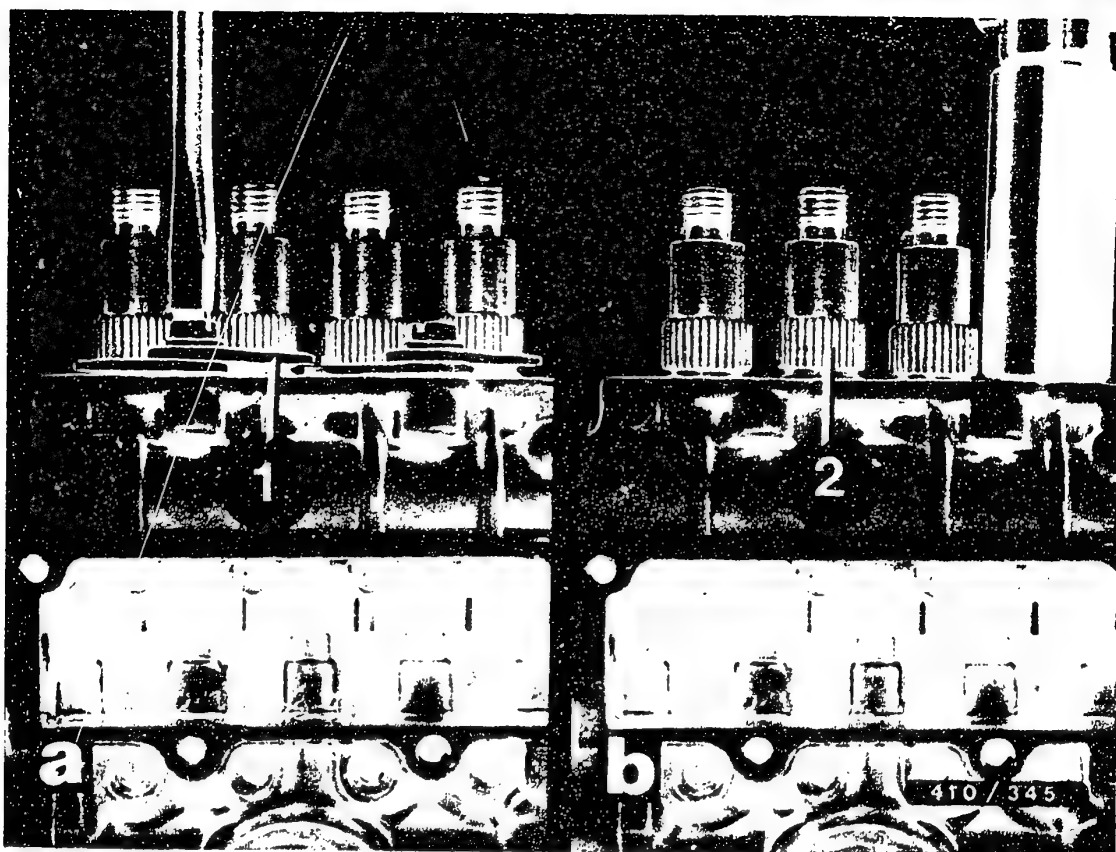
Remove control sleeve from stem of pump barrel.

C5

Disassembling injection pump

PES..M., 0 410..





1 = Support plate

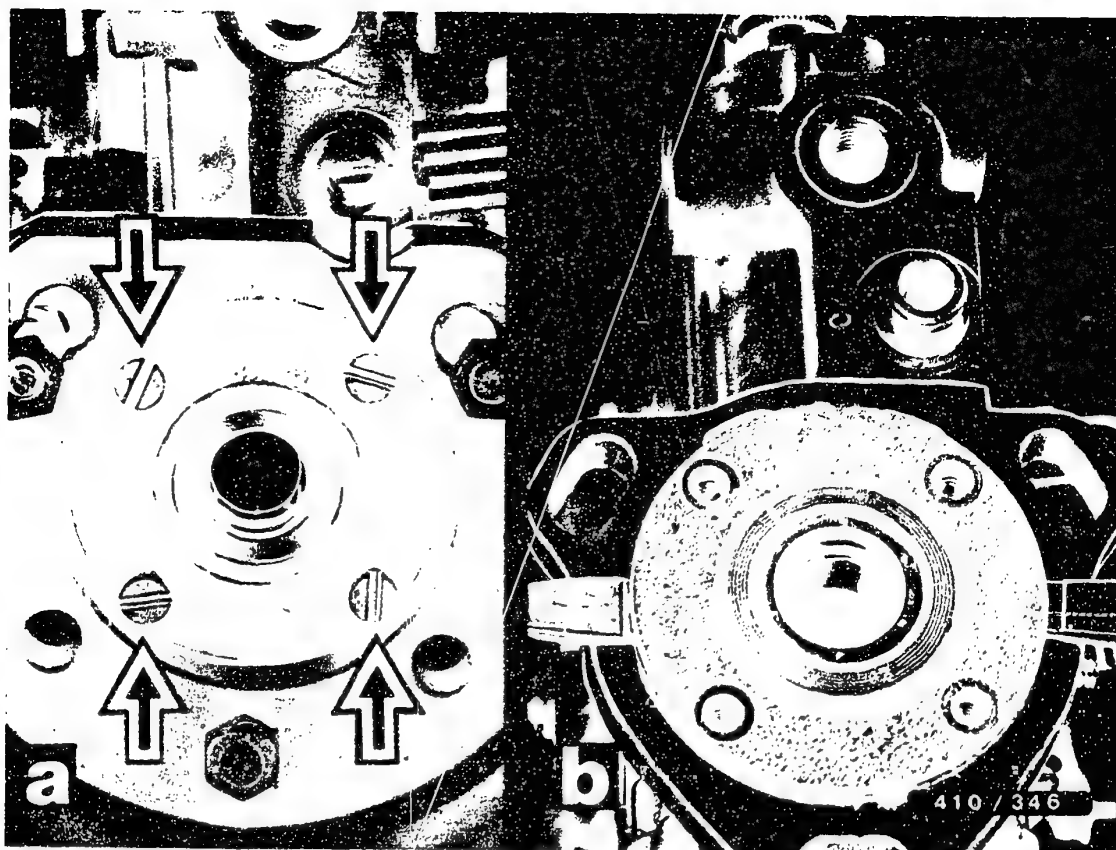
2 = Delivery-valve holder

Remove support plate or clamping jaws.

Loosen delivery-valve holder with socket wrench KDEP 2986 and set aside together with delivery valve and valve spring.

Note:

Set aside all parts belonging to one cylinder in storage compartments.

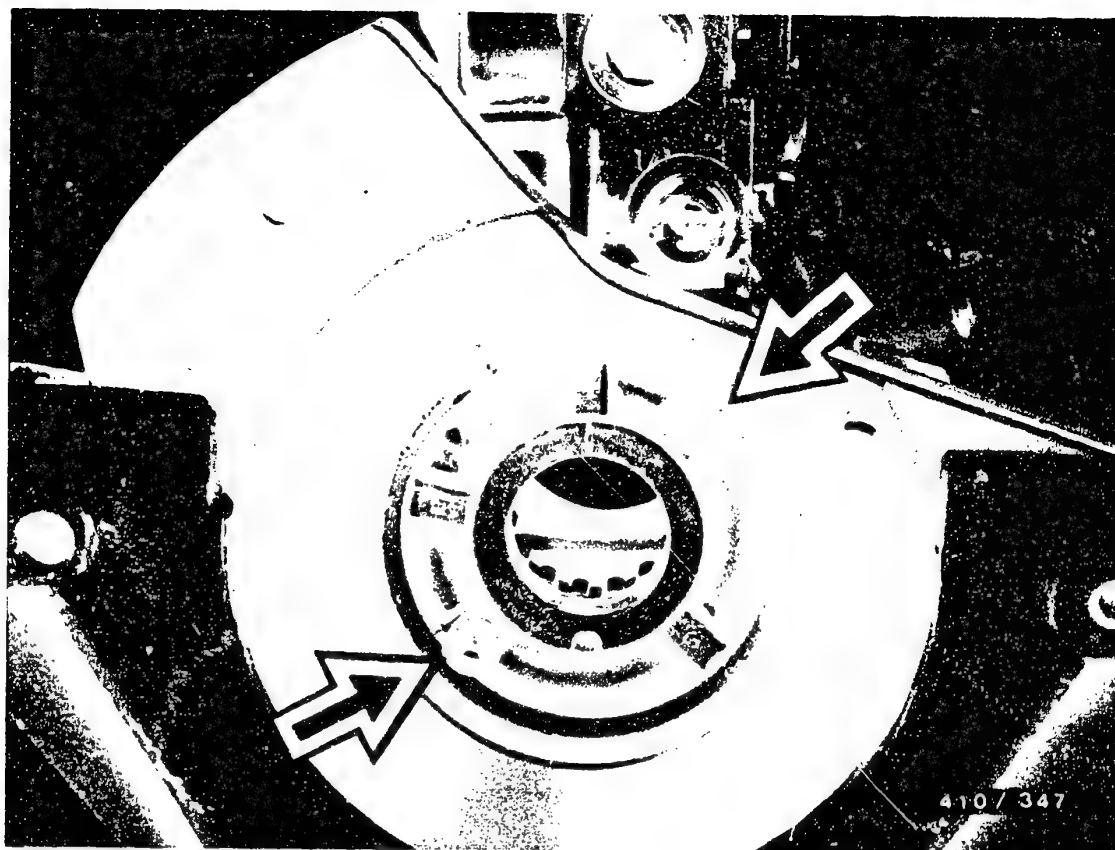


8.7 Removing bearing end plate

Remove fastening screws from bearing end plate (fig. a, arrows).

Lever bearing end plate evenly out of pump housing using screwdriver (fig. b).





8.8 Removing bearing end plate - pumps with FBG system

Remove Torx fastening screws from bearing end plate (arrows).

Unscrew injection pump from piping flange and take bearing end plate out of mounting hole.



9. Checking individual parts

9.1 Cleaning parts

Wash parts in a commercially-available flame-resistant cleaning agent, e.g. chlorothene NU. Subsequently blow dry with compressed air.

Observe the following safety regulations!

Regulation on work with combustible liquids (Vbf) from the West German Federal Ministry of Labor (BmA).

Safety rules for handling chlorinated hydrocarbons,
for firms ZH 1/222
for individuals ZH 1/119
from the Hauptverband für Gewerbliche Berufsgenossen-
schaften (Zentralverband für Unfallschutz und Arbeits-
medizin) Langwartweg 103, 5300 Bonn 5.

Outside West Germany, observe the corresponding regulations.

Replace worn or damaged parts (always replace O-rings and gaskets).



Coding IP service parts with a part of the part number
The following explanation is intended to make it possible to compare the 10-digit part number with the number stamped or marked on the service part. This makes it possible to recognize individual parts which have been installed incorrectly.
The coding is done as follows:

Camshaft

The code is made up of the 1st and 6th through 10th digits of the part number, e.g.

<u>Part number</u>	<u>Code</u>
1 416 126 302	126 302

Assembly

The code is made up of the 1st and 5th through 10th digits of the part number, e.g.

<u>Part number</u>	<u>Code</u>
1 418 325 010	1 325 010

The assembly is marked such that the 1st and 5th through 7th digits of the part number are on the first side of the plunger control arm, and the 8th through 10th digits on the second side.

C 10

Checking individual parts

PES..M.., 0 410 ..



Delivery valve

The code is made up of six digits, whereof the 1st digit represents a company code number, with the other 5 digits showing the 6th through 10th digit of the part number, e.g.

Part number

Code

1 418 524 005

124 005

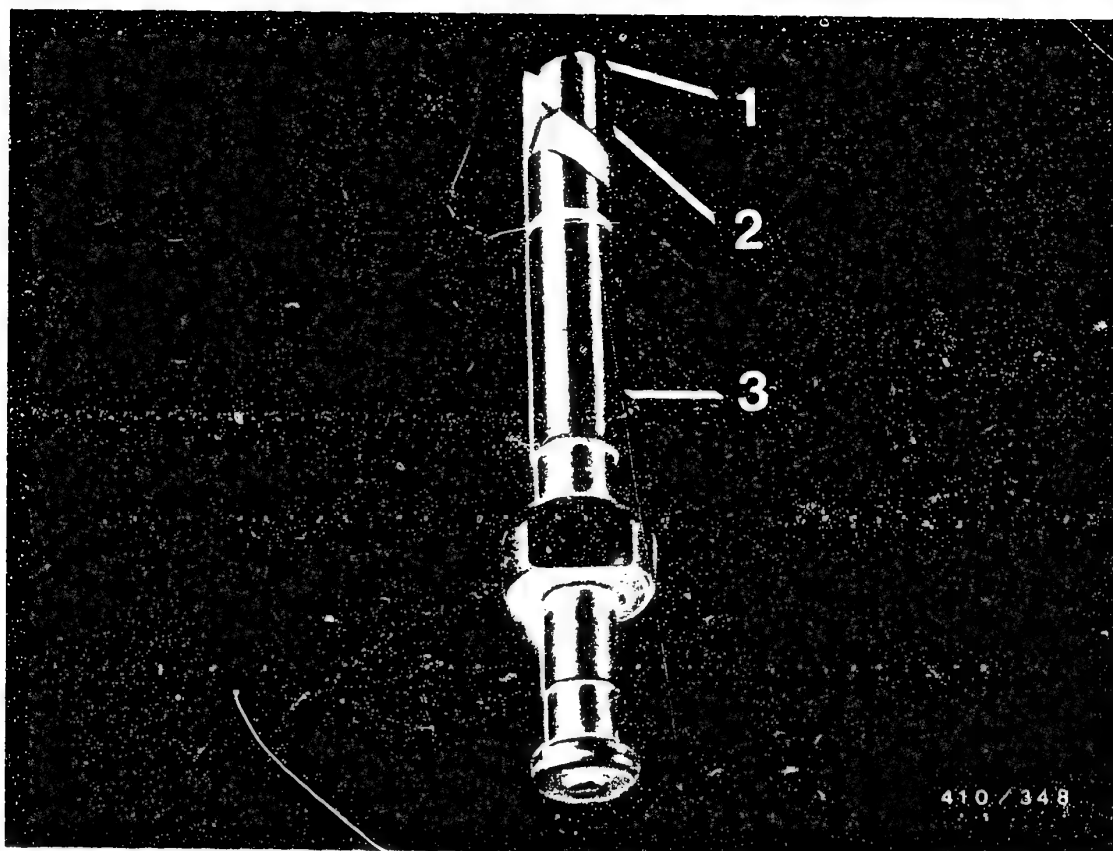
The valve cone is marked as before. The marking is done such that the first 3 digits of the code are found in the longitudinal groove and the other 3 digits in the opposite longitudinal groove. On delivery valves with cylindrical cones, the code is marked either on the end face of the cone or on the valve holder.

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Checking individual parts

PES..M.., 0 410 ..





1 = Control edge
2 = Head area

3 = Running surface

Checking plunger-and-barrel assemblies

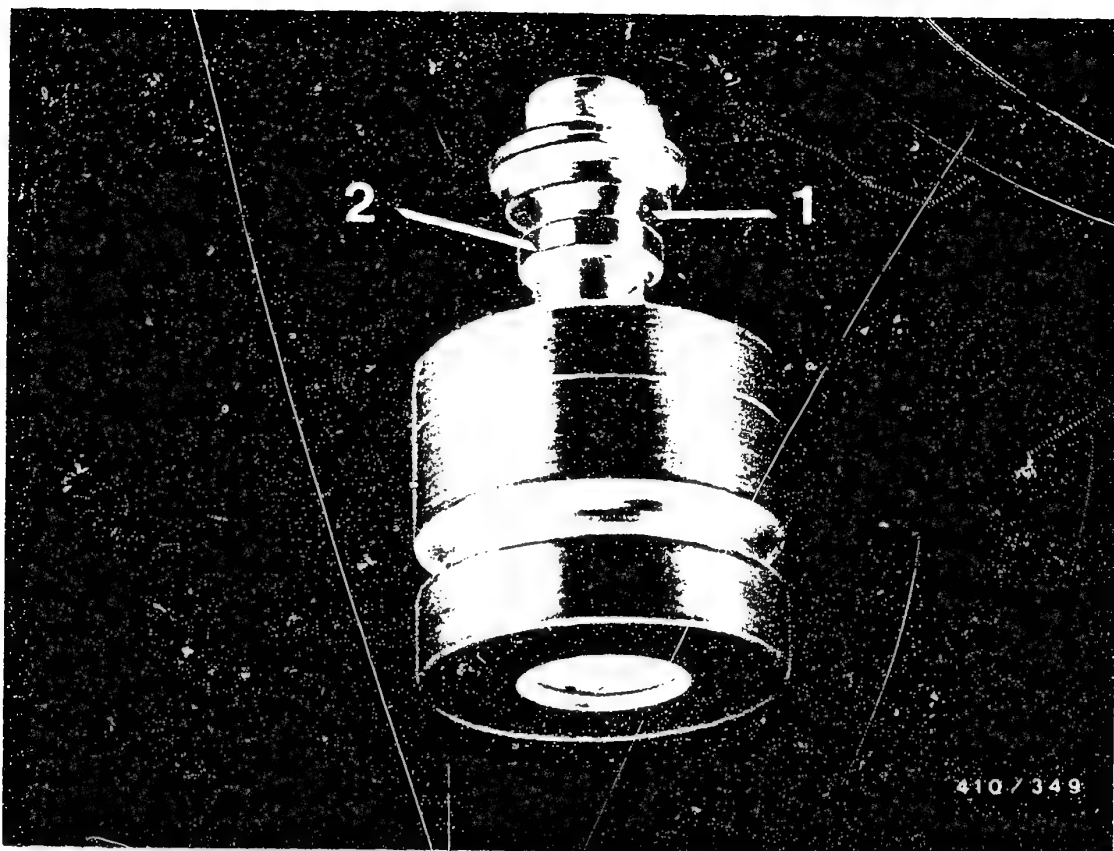
Replace plunger-and-barrel assemblies if they show the following characteristics:

- Rounded-off control edges
- Dull areas in the head area
- Running marks on running surfaces
- Sticking assemblies (ascertainable by slide test)

Note:

Before the slide test, wash the plunger-and-barrel assembly, plunger, and cylinder in calibrating oil. Hold plunger and cylinder almost vertical. The pump plunger should slide down by its own weight.





1 = Valve cone

2 = Retraction piston

Testing delivery valves

The seating surface of the valve code must not be indented or unevenly worn.

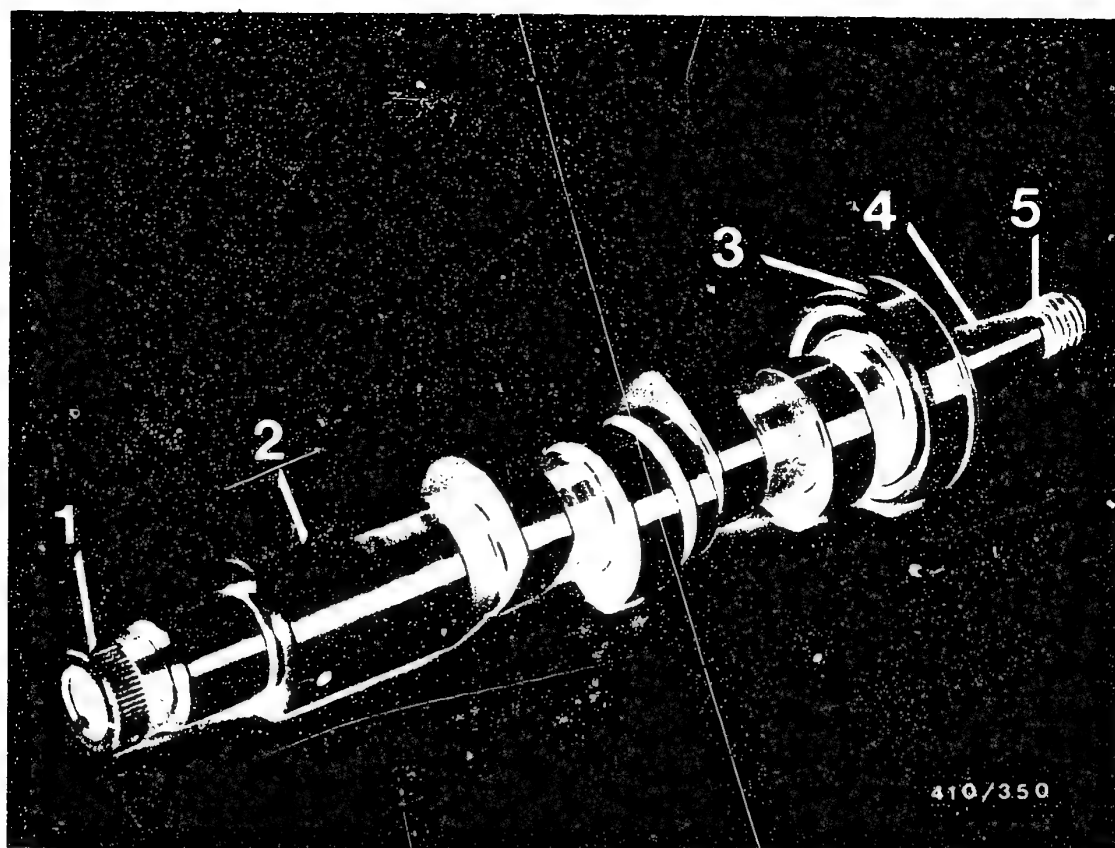
If the retraction piston is damaged (grooves), or if the valve sticks in the valve holder, replace delivery valve.

C13

Checking individual parts

PES..M.., 0 410 ..





1 = Serration
2 = Drive shaft
3 = Camshaft bearing

4 = Cone
5 = Threaded end

Checking camshaft

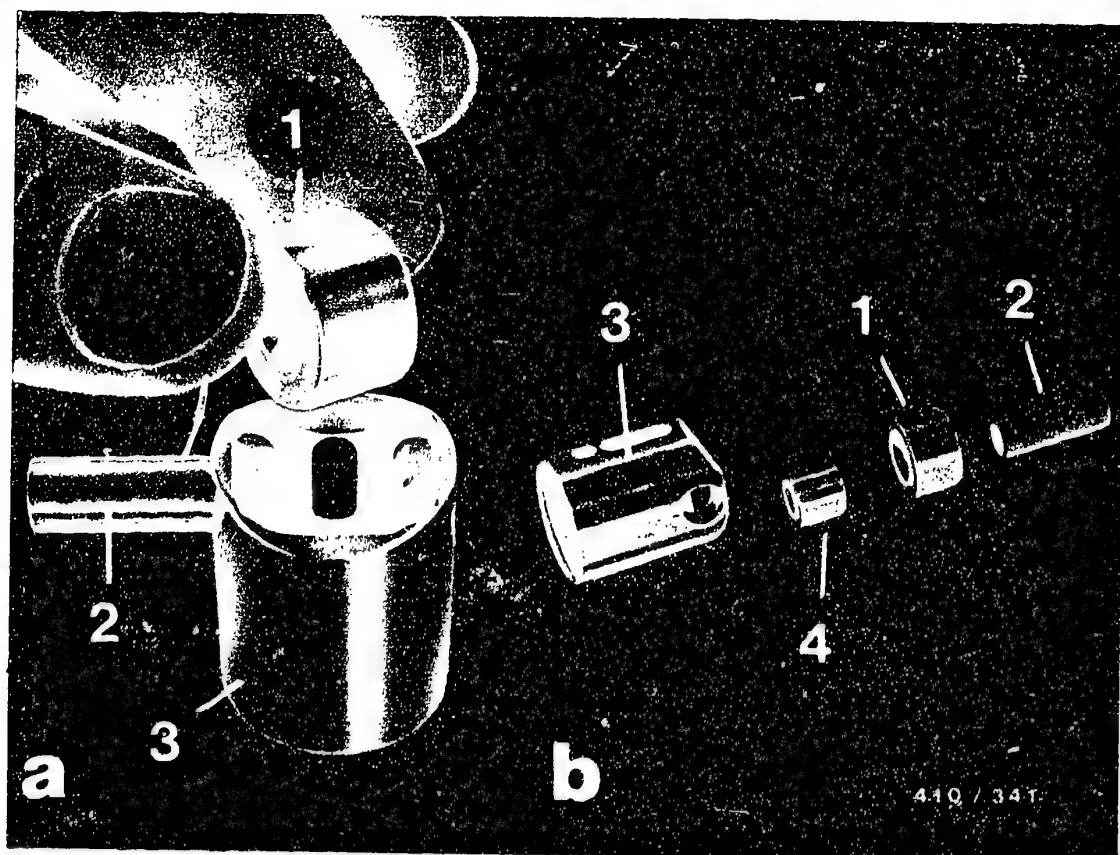
Visually inspect camshaft for:

- Severe running marks on cams
 - Worn, damaged key groove
 - Damage to threaded end or cone
 - Damage to serration or shaft for drive bearing
- Replace camshaft if justified by complaint.

Note:

Replace camshaft bearings in all repairs as a matter of course.





1 = Roller
2 = Bearing pin

3 = Roller-tappet shell
4 = Bushing

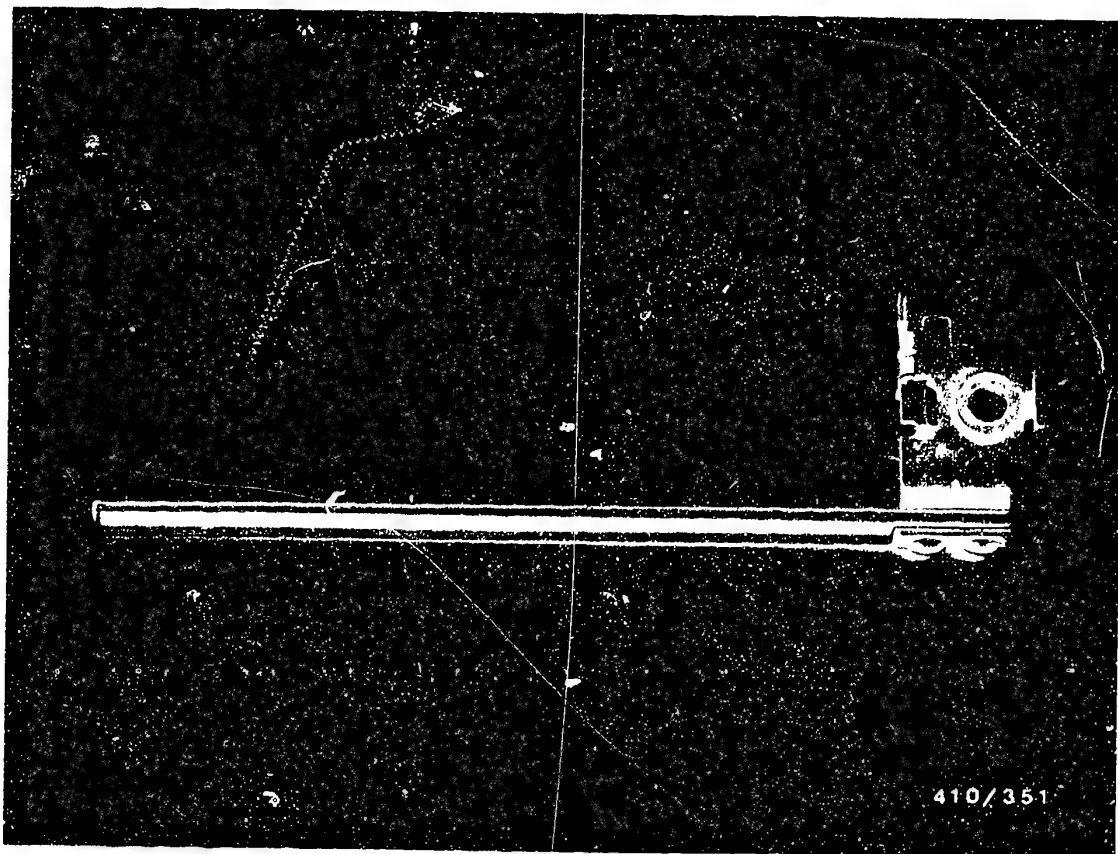
Checking roller tappets

Replace roller tappets or individual parts if the following damage is found:

- Severe running marks on roller-tappet shell
- Severe running marks and/or discoloration on roller, bushing, or bearing pin.

Notes: If roller-tappet shell shows severe running marks, check roller-tappet guide and pump housing for grooving.





Checking control rod

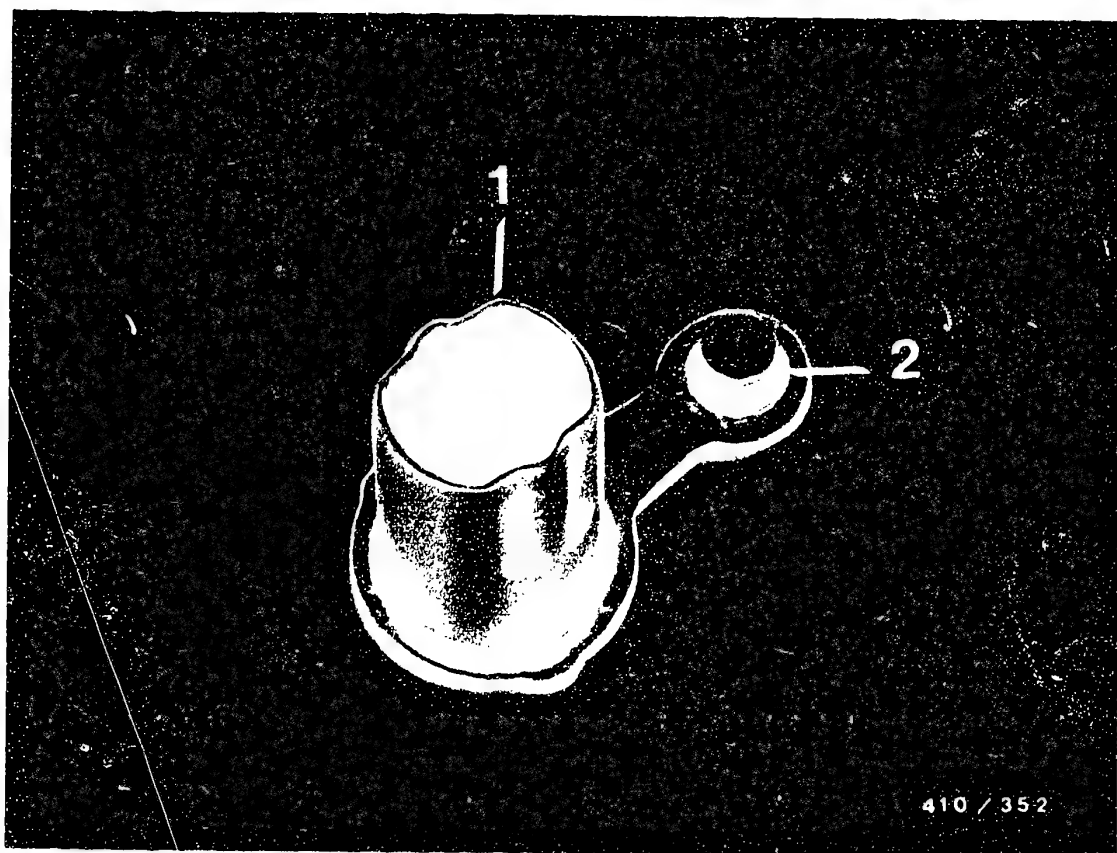
Check control rod for running marks and ease of movement in housing.

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Checking individual parts

PES..M.., 0 410 ..





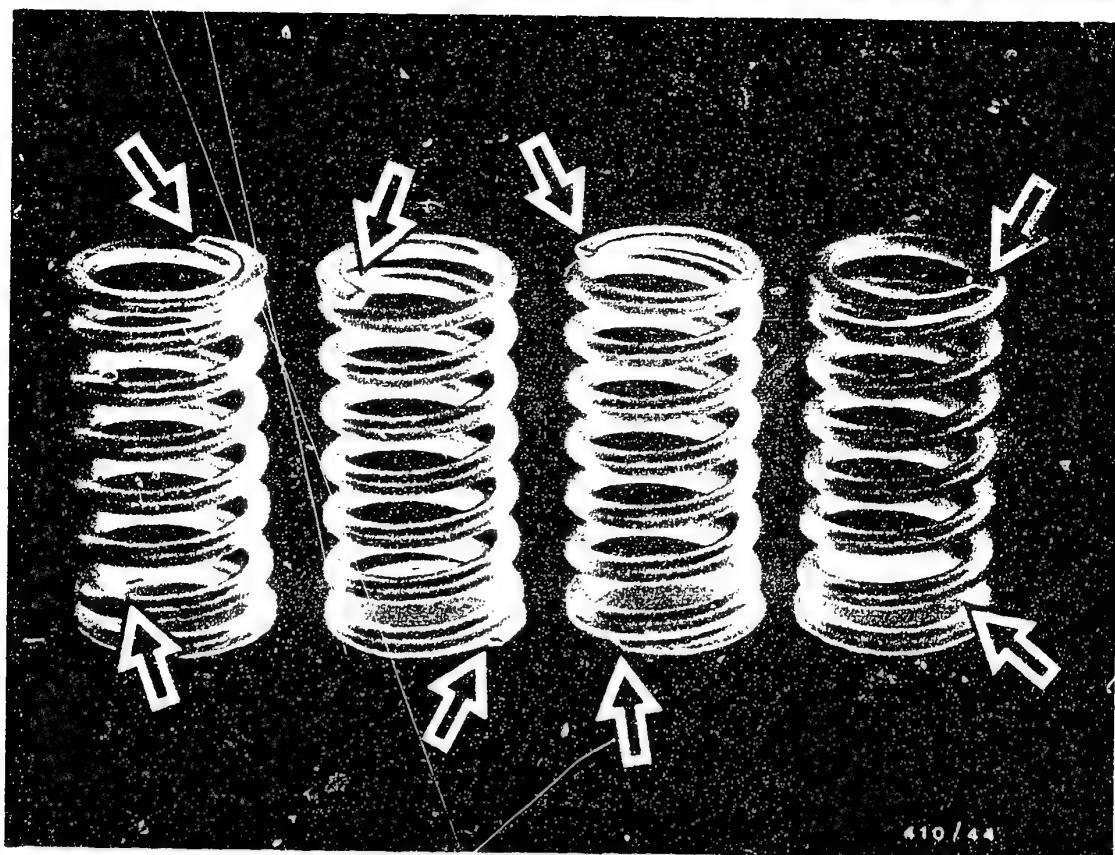
1 = Plunger control arm guide 2 = Linkage lever

Checking control sleeve

Replace control sleeve if following damage is found:

- Deformation of plunger control arm guide
- Bent linkage lever





Checking plunger return springs

Corroded plunger return springs, or those showing surface damage, must be replaced due to the danger of breakage.

Pay particularly close attention to the area of the 1st coil seating surface (see illustration, arrows).



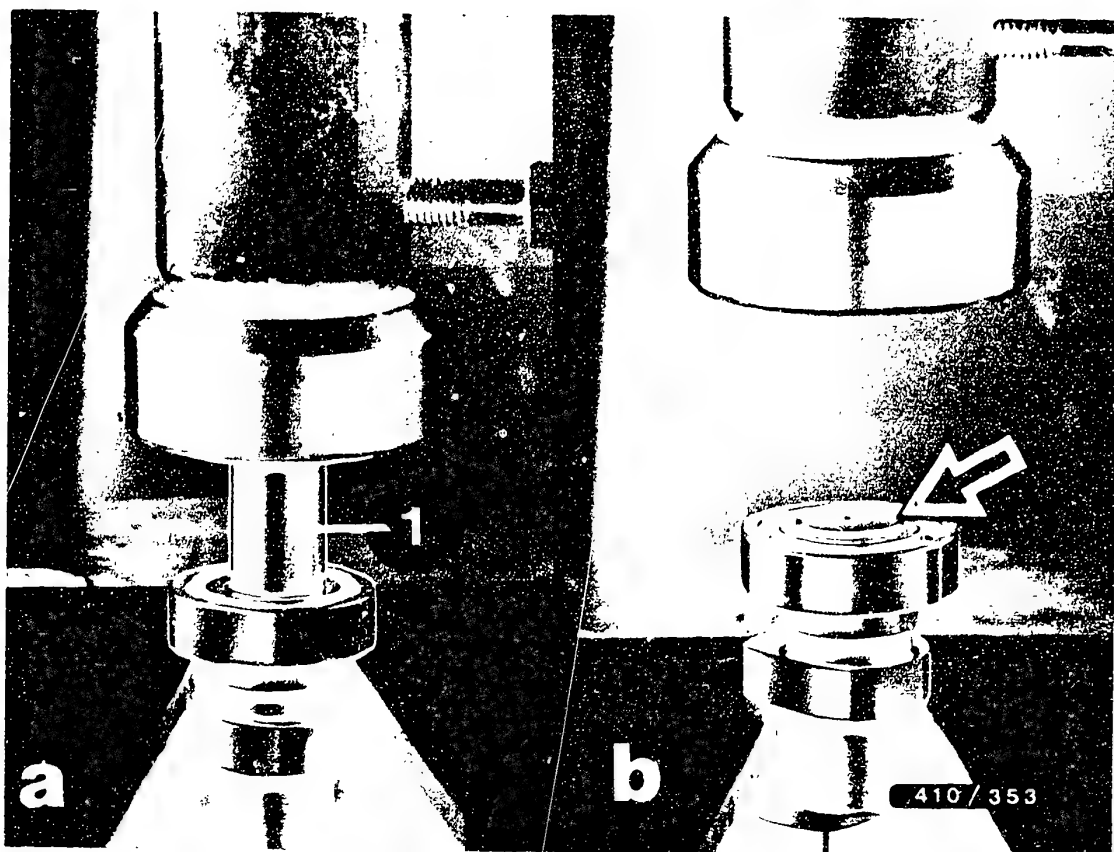
Checking pump housing

Check housing for cracks and other external damage.

In particular, inspect:

- Threads on stay bolts and inserts
- Roller-tappet guides, for grooving
- Control rod in its guide, for freedom of movement
- Suction gallery, for cavitation
- Plunger-and-barrel assembly seats for unevenness/fuel deposits





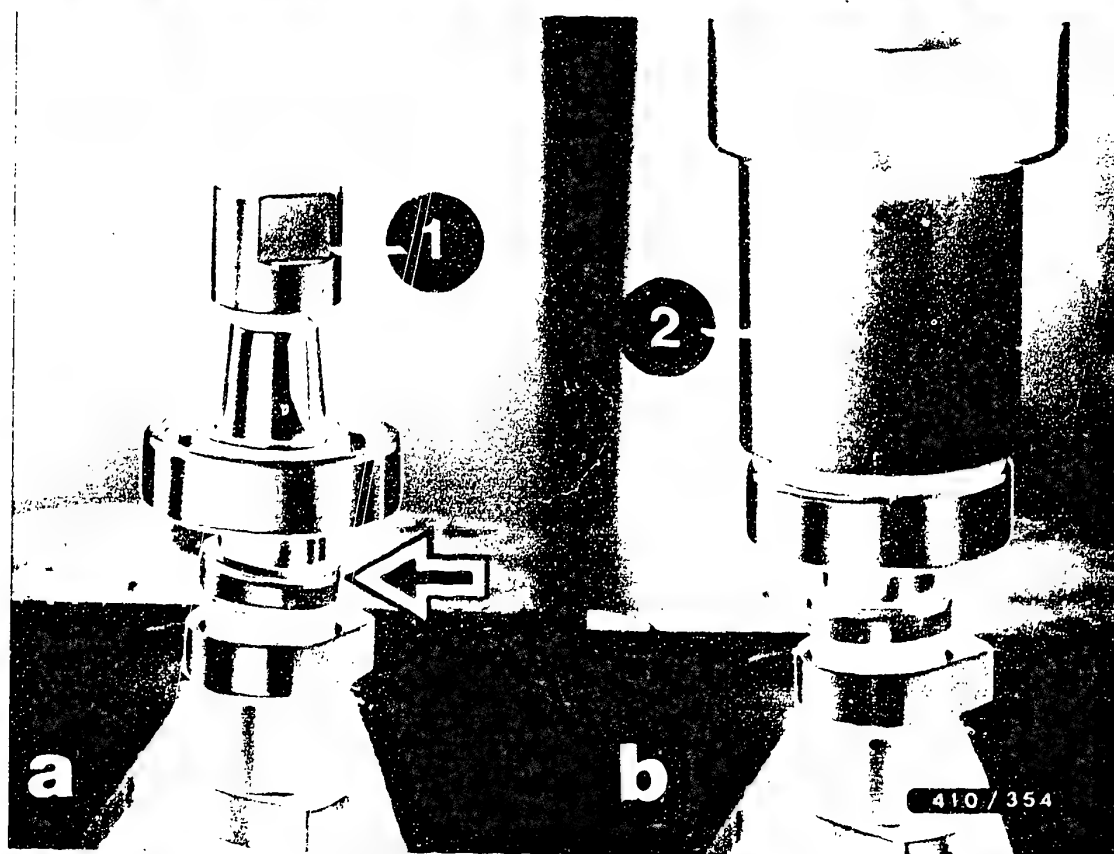
10. Repairing individual parts

10.1 Replacing camshaft bearings/pump with pneumatic governor

Push camshaft into pressing plate KDEP 1580, until bearing collar rests on plate on both sides (fig. a). Place sleeve (1) on camshaft end (fig. b, arrow) on governor side.

Press off camshaft bearing under arbor press, being careful of shims for axial play adjustment. Turn camshaft and press off drive-side bearing.





1 = Guide sleeve

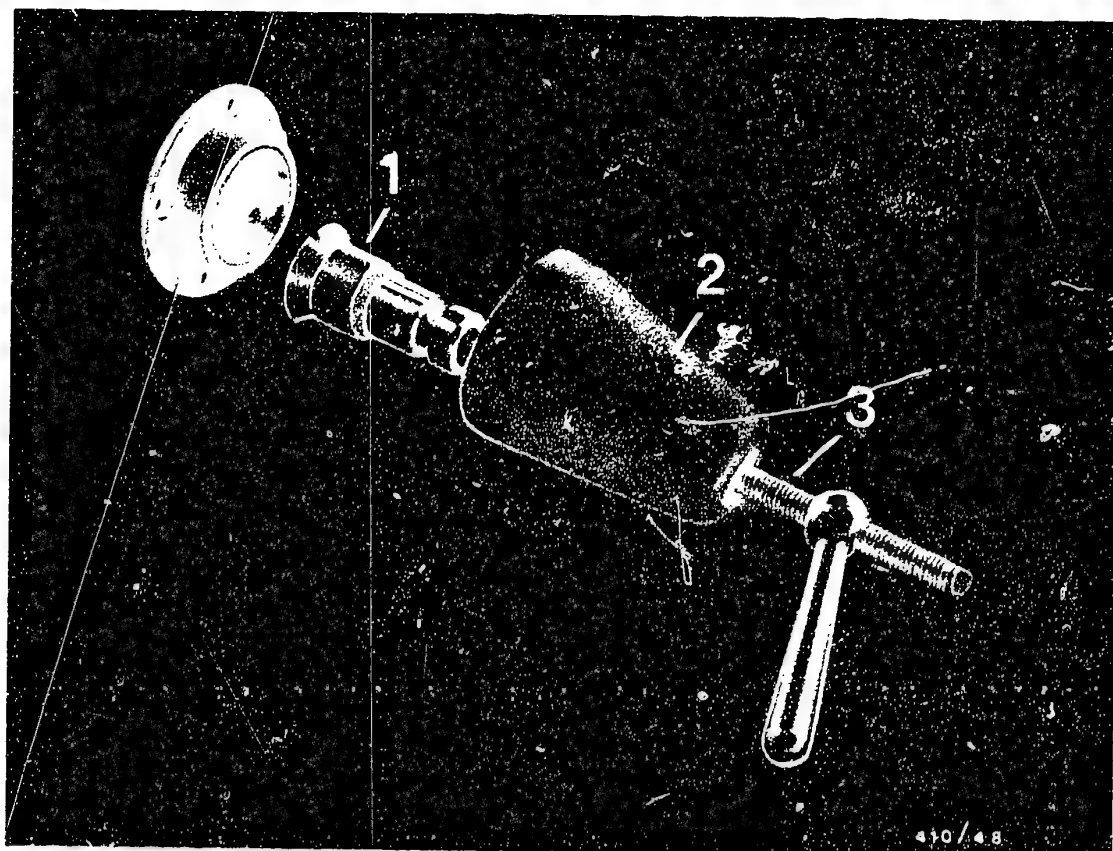
2 = Press-in sleeve

Press new camshaft bearings on to drive and governor sides, and previous shims (arrow) on camshaft cone. Screw on guide sleeve (found in parts set for press-in tool KDEP 1049).

Place press-in sleeve over guide sleeve and press on deep-groove ball bearing under arbor press.

Note: Apply pressure only on inner race.





- 1 = Spring collet
- 2 = Puller cone
- 3 = Threaded pin

10.2 Replacing bearing outer races, radial sealing rings, and camshaft bearings

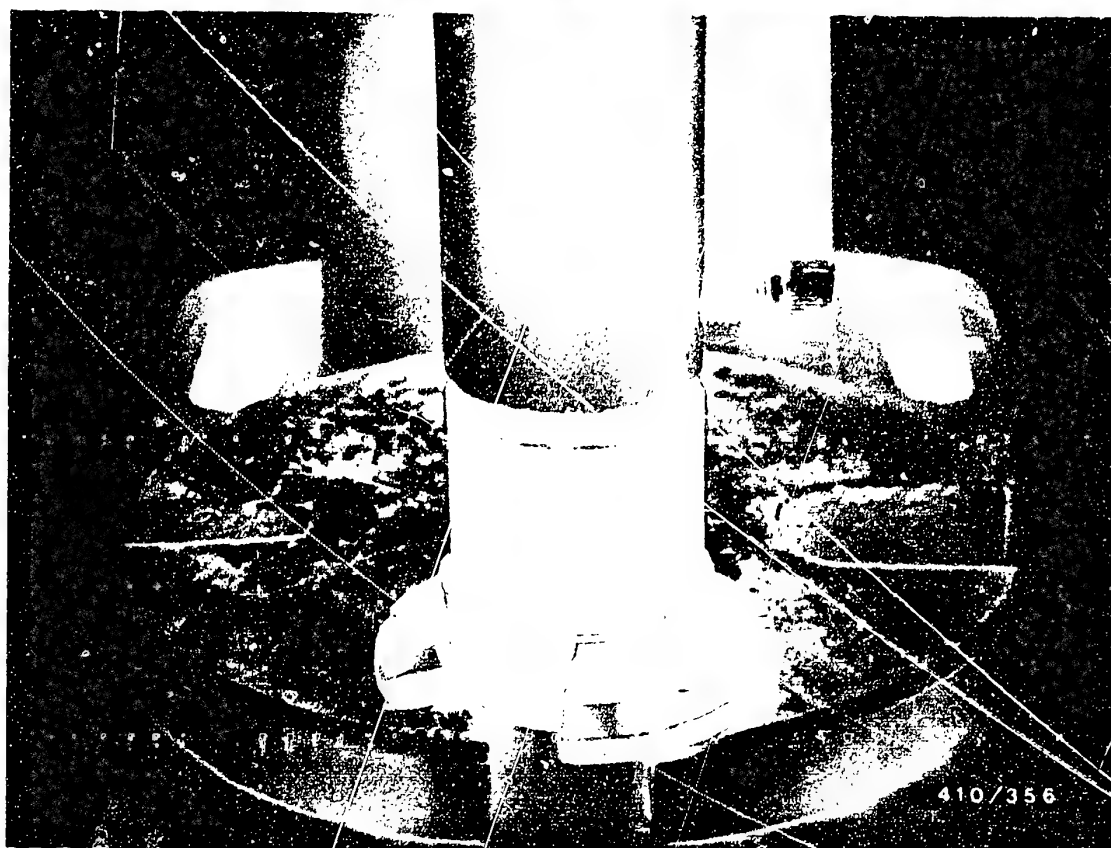
Pumps without FBG system

Replace bearing outer races.

Pull bearing outer races out of drive-side bearing end plate with puller (see illustration).

Note:

Use puller from tool board KDAW-T 100.

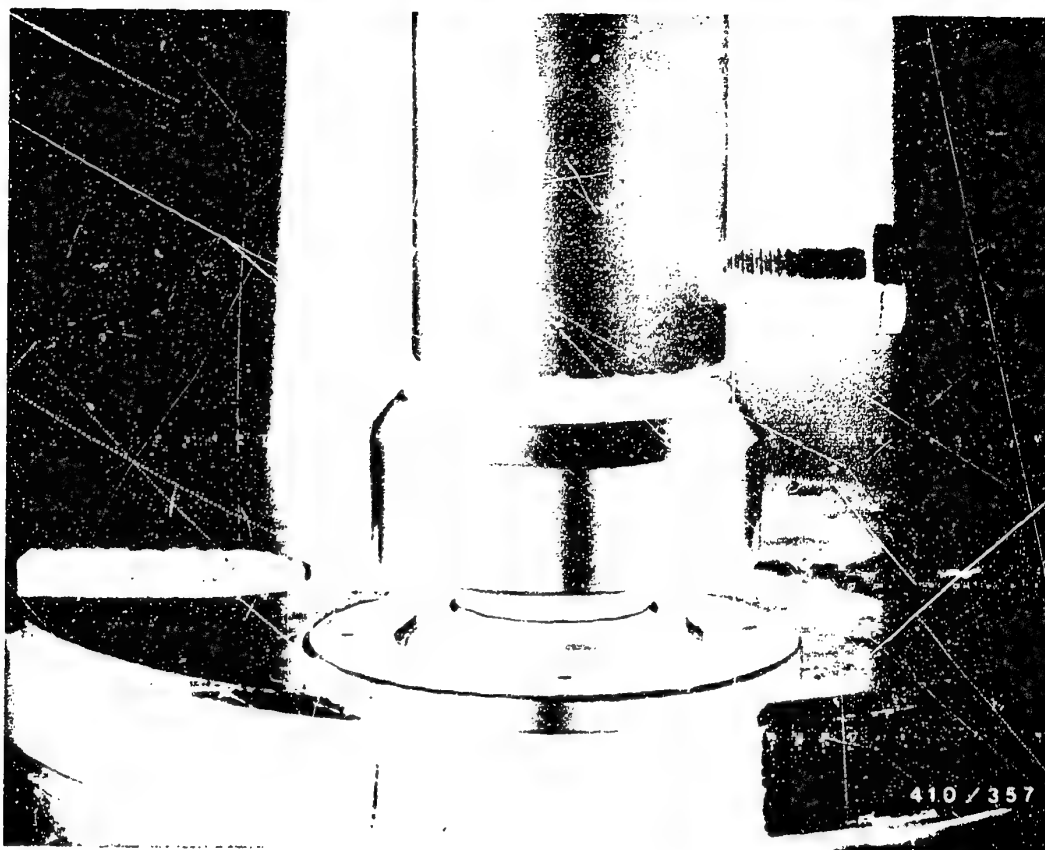


Press new bearing outer race into drive-side bearing end plate up to bearing seat under arbor press.

C23

Repairing individual parts
PES..M.., 0 410 ..

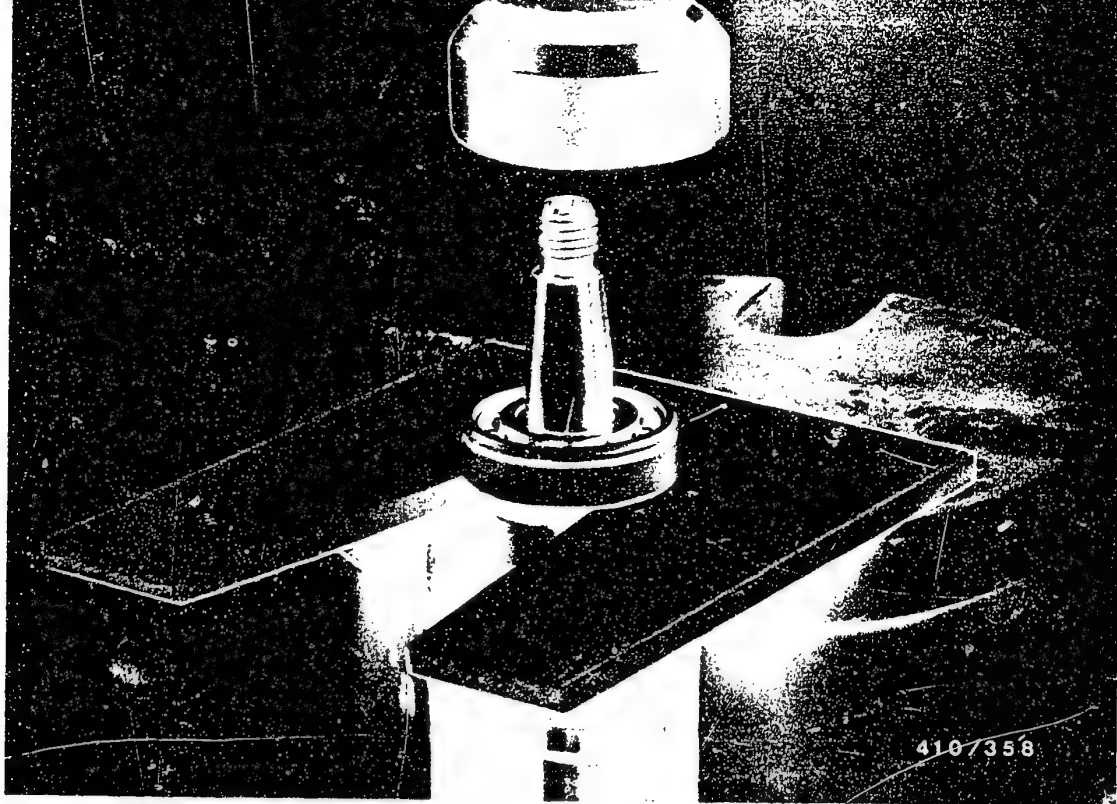




Replacing radial sealing rings

Lightly oil outside of new radial-lip-type oil seal and press in flush into drive-side bearing end plate.





Replacing camshaft bearings

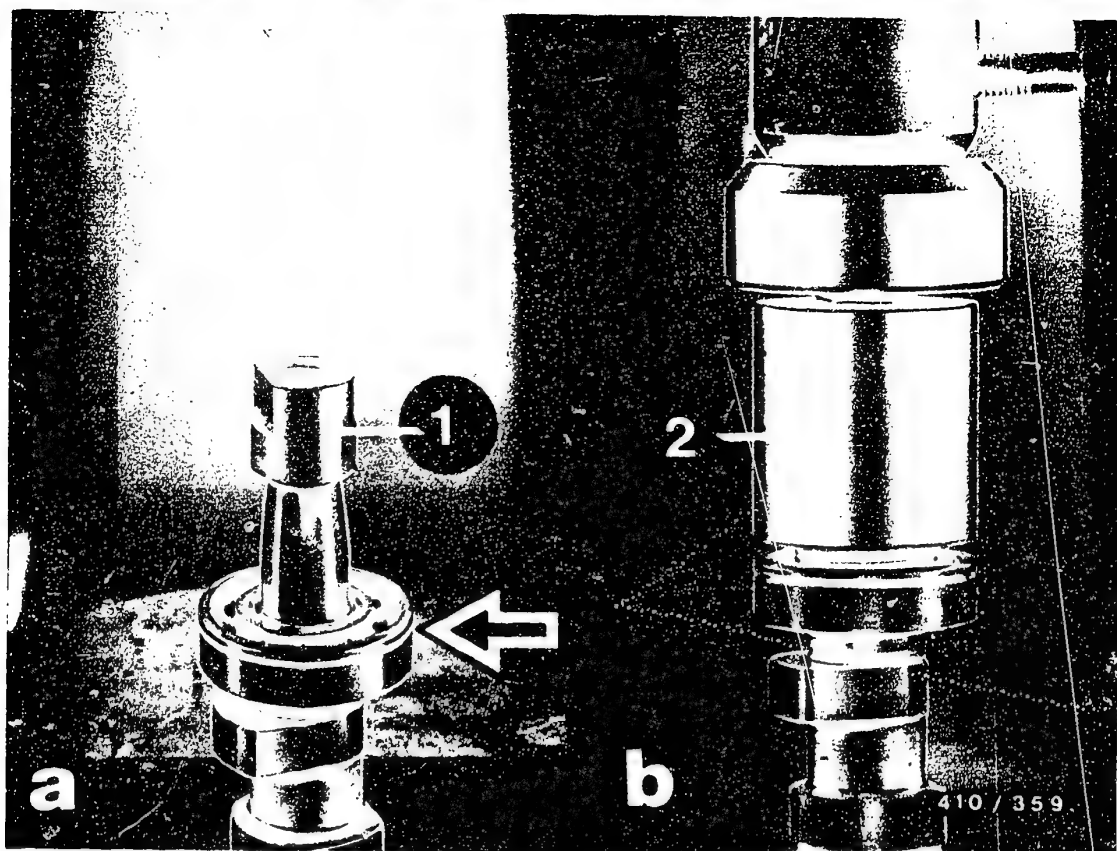
Press off camshaft bearing under arbor press using pressing plate KDEP 1580.

Note:

The pressing plate is suitable for all camshaft diameters.

Thus, push camshaft into cut-out until bearing collar rests on plate on both sides (see illustration).





1 = Guide sleeve

2 = Press-in sleeve

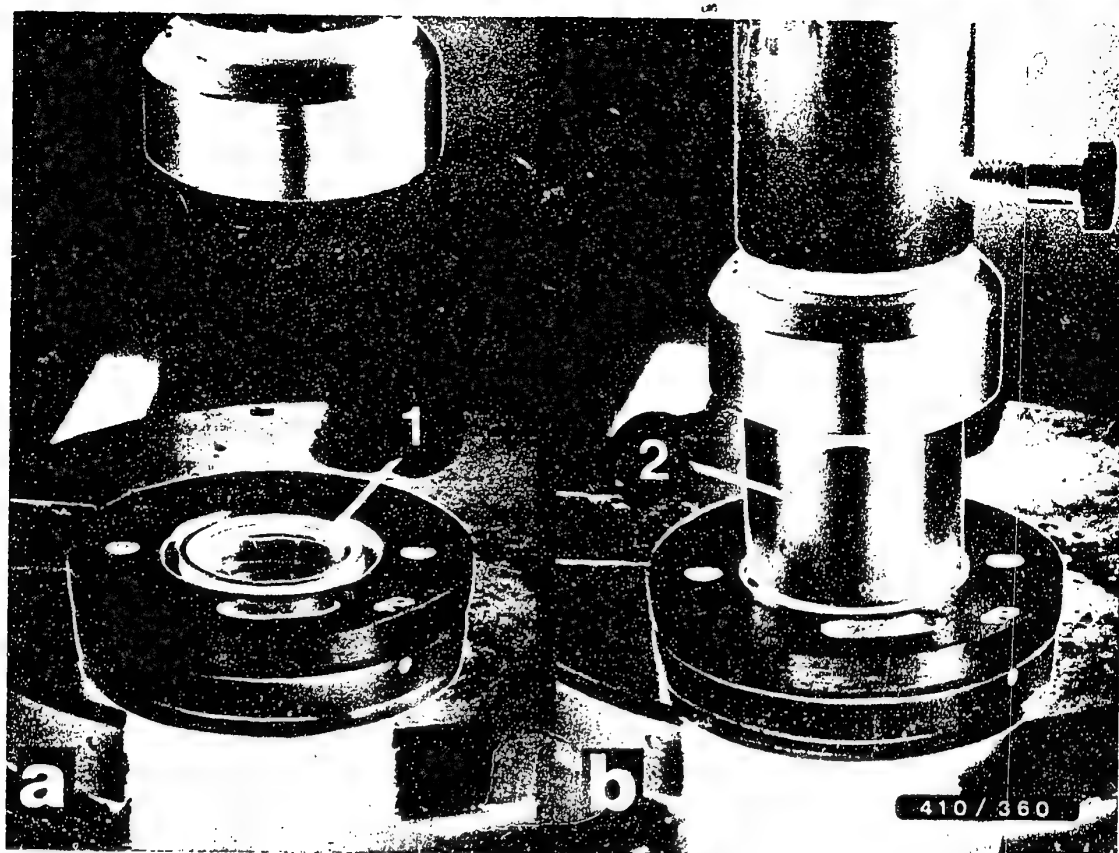
Screw guide sleeve (found in parts set of press-in tool KDEP 1049) on to camshaft.

Push press-in sleeve over guide sleeve and press new deep-groove ball bearing on under arbor press. Apply pressure only to the inner race.

Note:

Groove in outer race (arrow) faces towards cone.





1 = Radial sealing ring 2 = Press-in sleeve

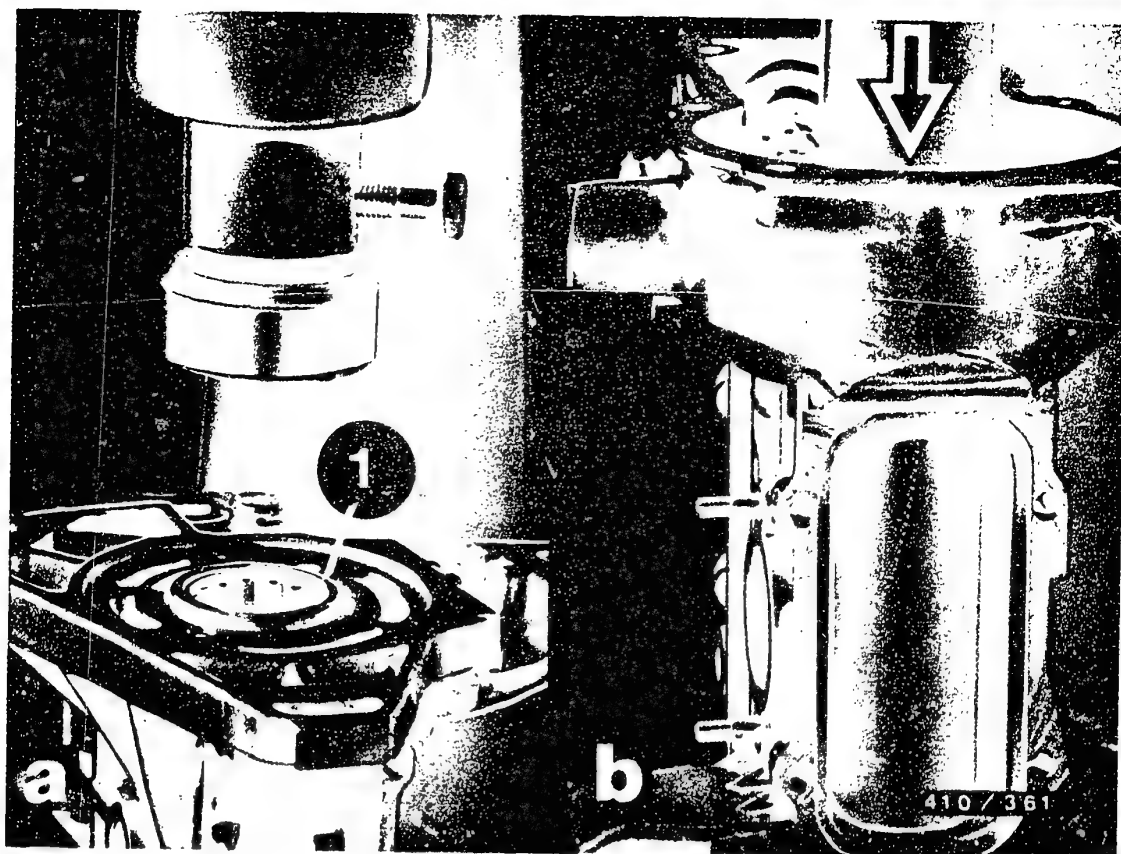
Replacing radial sealing rings and camshaft bearings
on drive and governor sides

Pumps with FBG system

- Replacing radial sealing rings

Remove radial sealing ring with commercially-available tool. Be sure not to damage boring in the process.

Use press-in sleeve KDEP 1576 to press new radial sealing ring in to stop on bearing end plate.

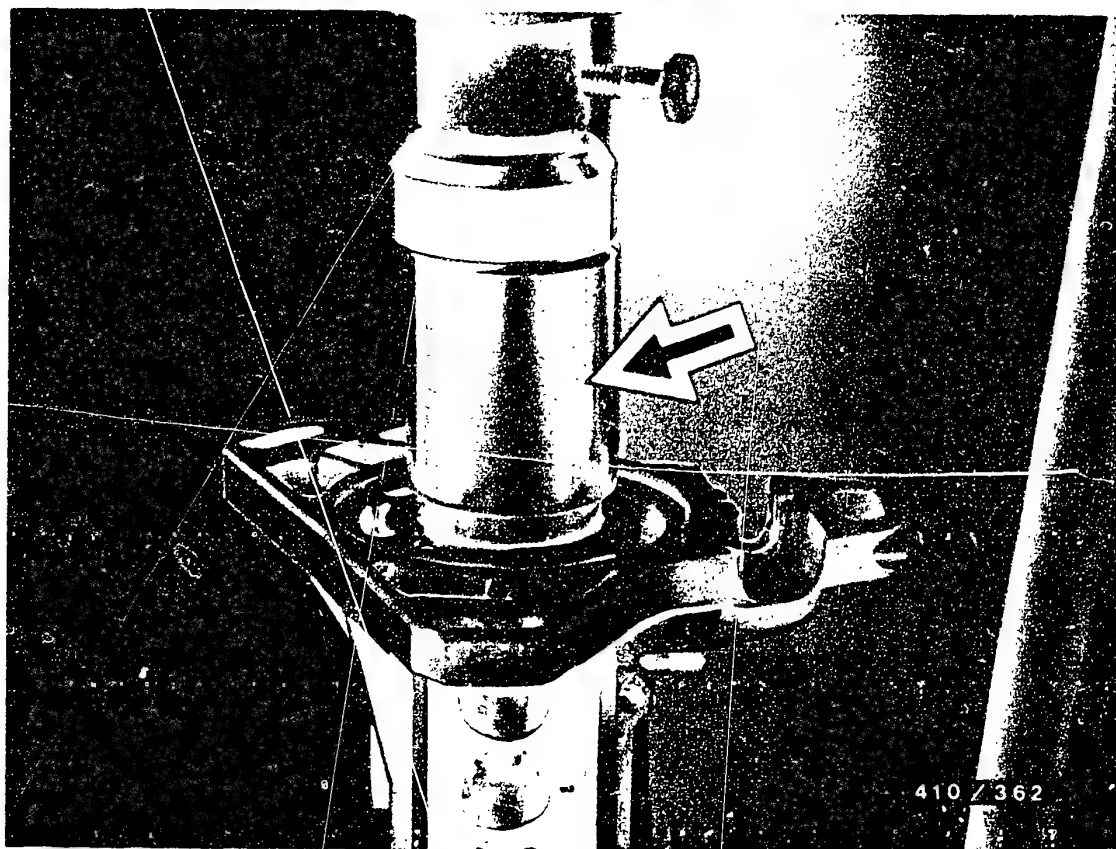


1 = Camshaft bearing

- Replacing drive-side camshaft bearing

Use mandrel KDEP 1566 (arrow) to press camshaft bearing out of pump housing on drive side.





Arrow = Press-in sleeve

Use press-in sleeve KDEP 1567 to press drive-side camshaft bearing in to stop on pump housing.

Note:

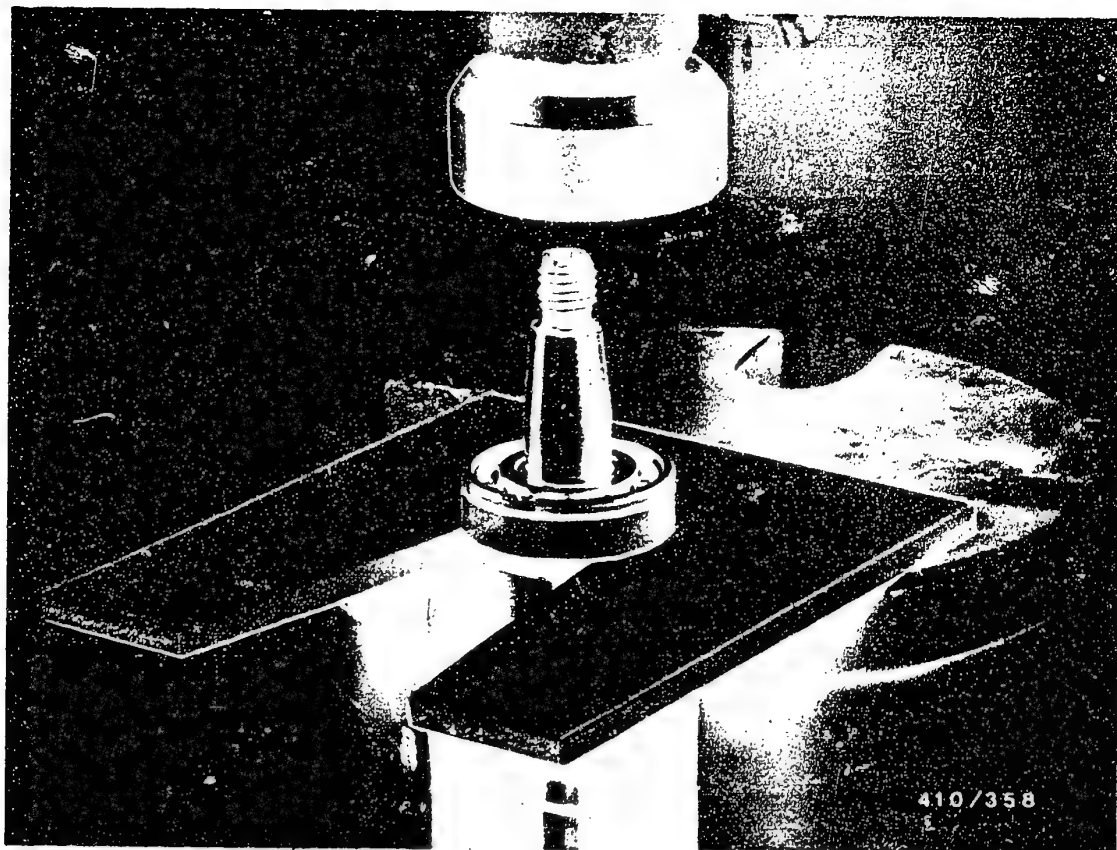
Apply pressure only to outer race.

D5

Repairing individual parts

PES..M.., 0 410 ..





- Replacing governor-side camshaft bearing

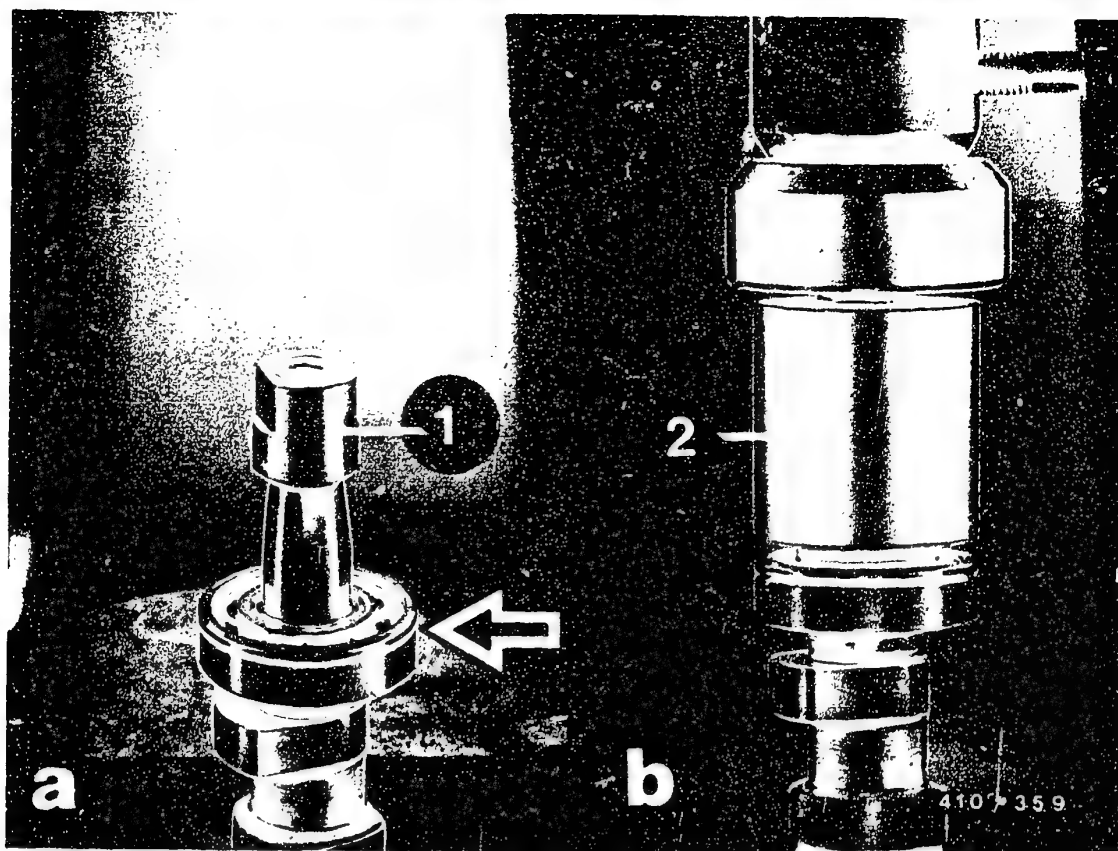
Press off camshaft bearing under arbor press using pressing plate KDEP 1580.

Note:

The pressing plate is suitable for all camshaft diameters.

Thus, push camshaft into cut-out until bearing collar is resting on the plate on both sides (see illustration).





1 = Guide sleeve

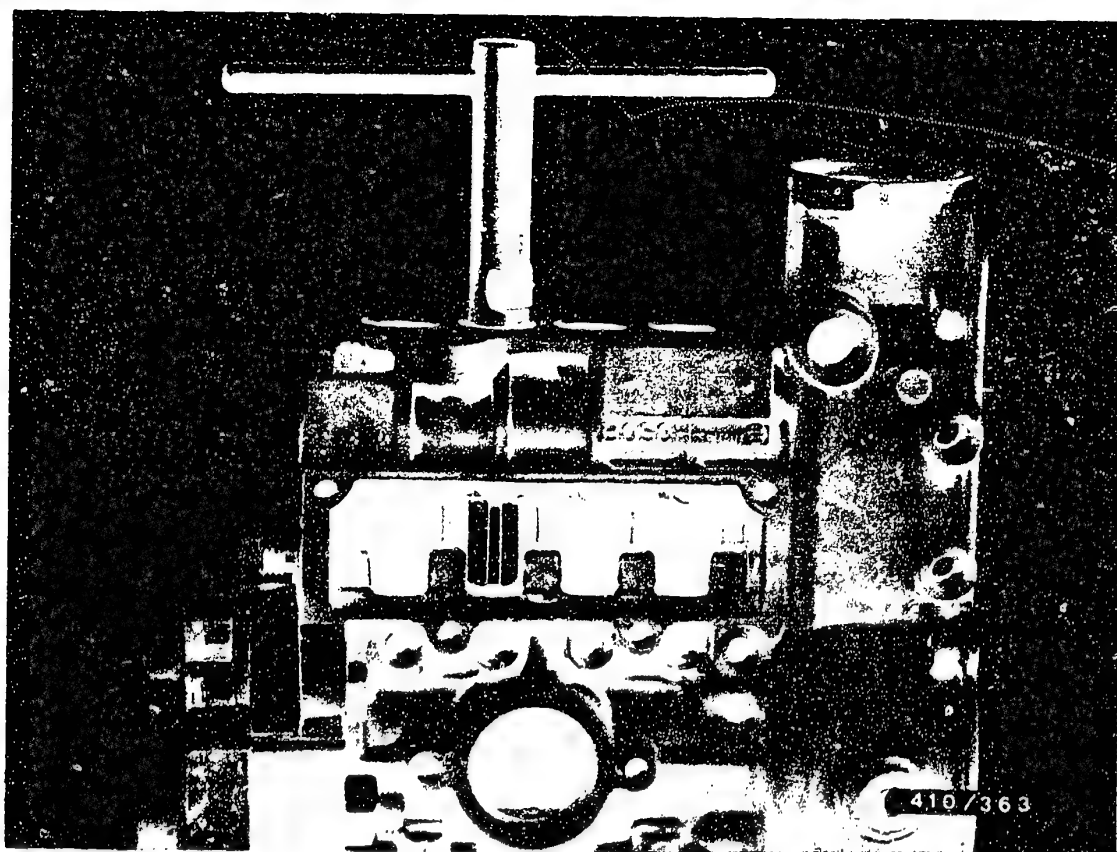
2 = Press-in sleeve

Screw guide sleeve (found in parts set of press-in tool KDEP 1049) onto camshaft.

Push press-in sleeve over guide sleeve and press on new deep-groove ball bearing under arbor press. Apply pressure only to inner race.

Note:

Groove in outer race (arrow) faces cone.



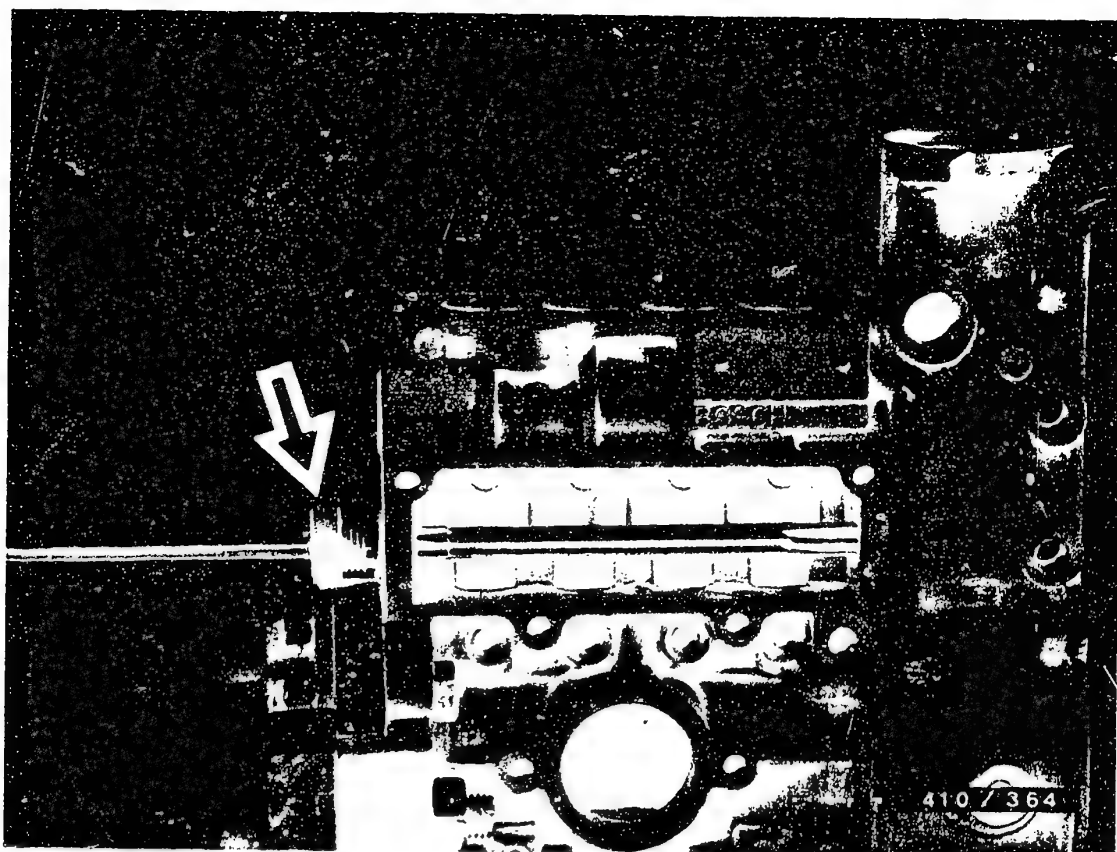
10.4 Dressing plunger-and-barrel assembly seats

Carefully remill (smooth) assembly seat using hand miller KDEP 2956, being sure not to apply excessive pressure, in order to remove unevenness and fuel deposits.

Note:

After working, wash out pump housing with cleaning agent.





Arrow = Guide sleeve

10.5 Dressing control-rod guide bushings

Ream out control-rod guide bushings with reamer KDEP 2996 and guide sleeve.

Note:

After reaming out the guide bushings, the control rod should be able to be easily pushed without canting. Thoroughly wash out pump housing.

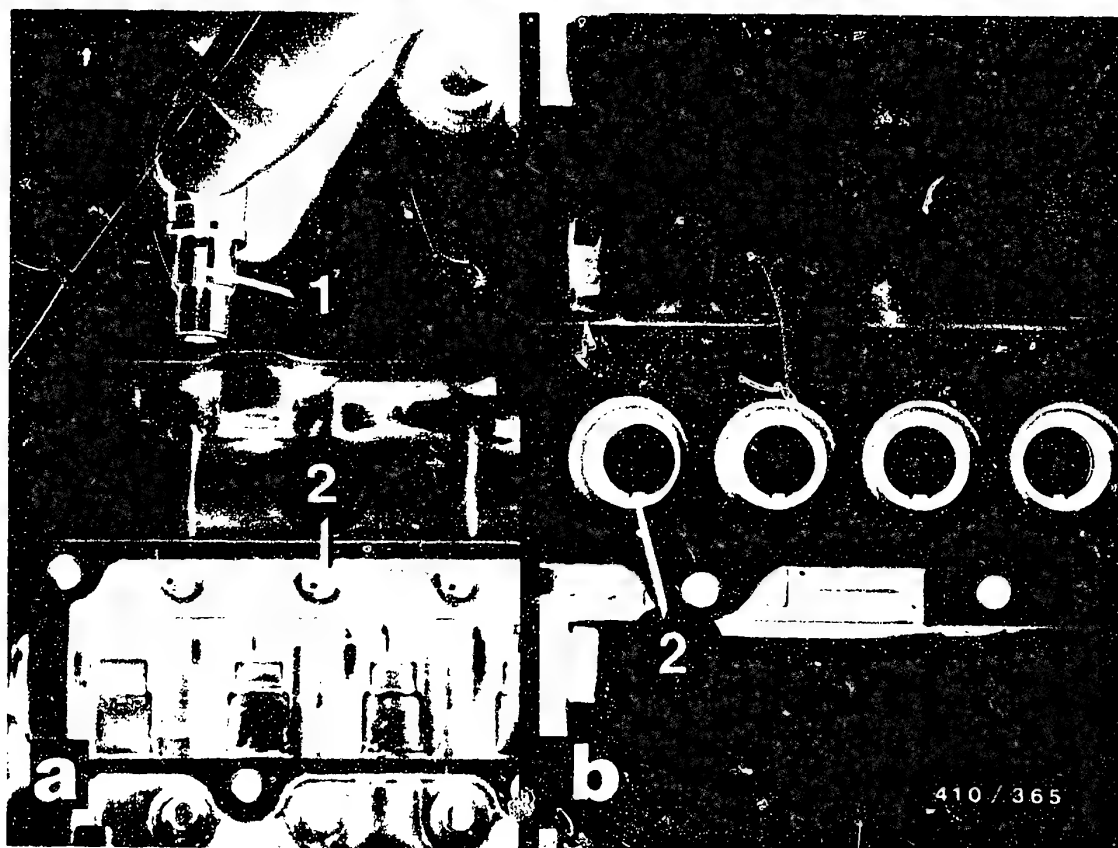


11. Assembling injection pump

Clamp in injection pump housing as appropriate for pump version.

In the following work steps, use only cleaned parts which are not worn or damaged.





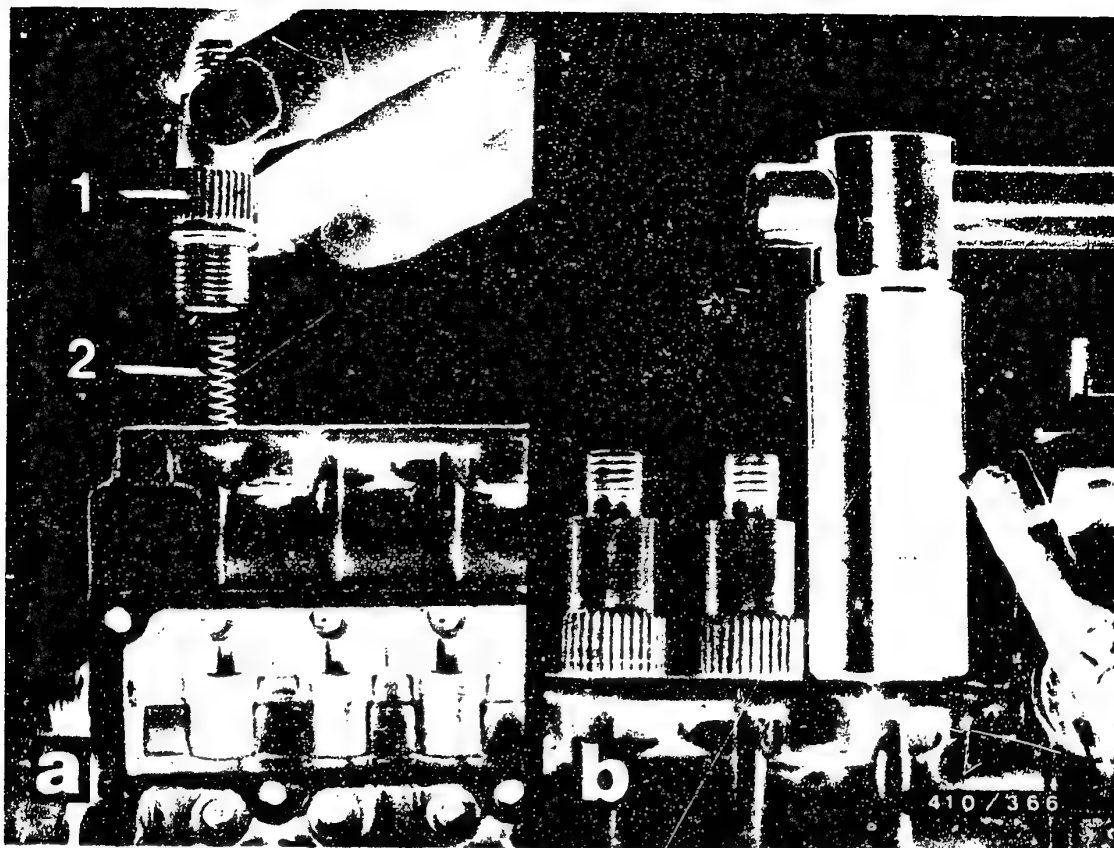
1 = Guide groove

2 = Locating pin

11.1 Installing pump barrels and delivery valves

Insert pump barrel into housing in such a way that the locating pin catches in the guide groove. This secures the barrel against twisting.





1 = Delivery-valve holder 2 = Compression spring

Insert delivery valves with new seals into housing.
Position compression springs and tighten
delivery-valve holders with the correct tightening
torque and procedure, depending on the pump version.

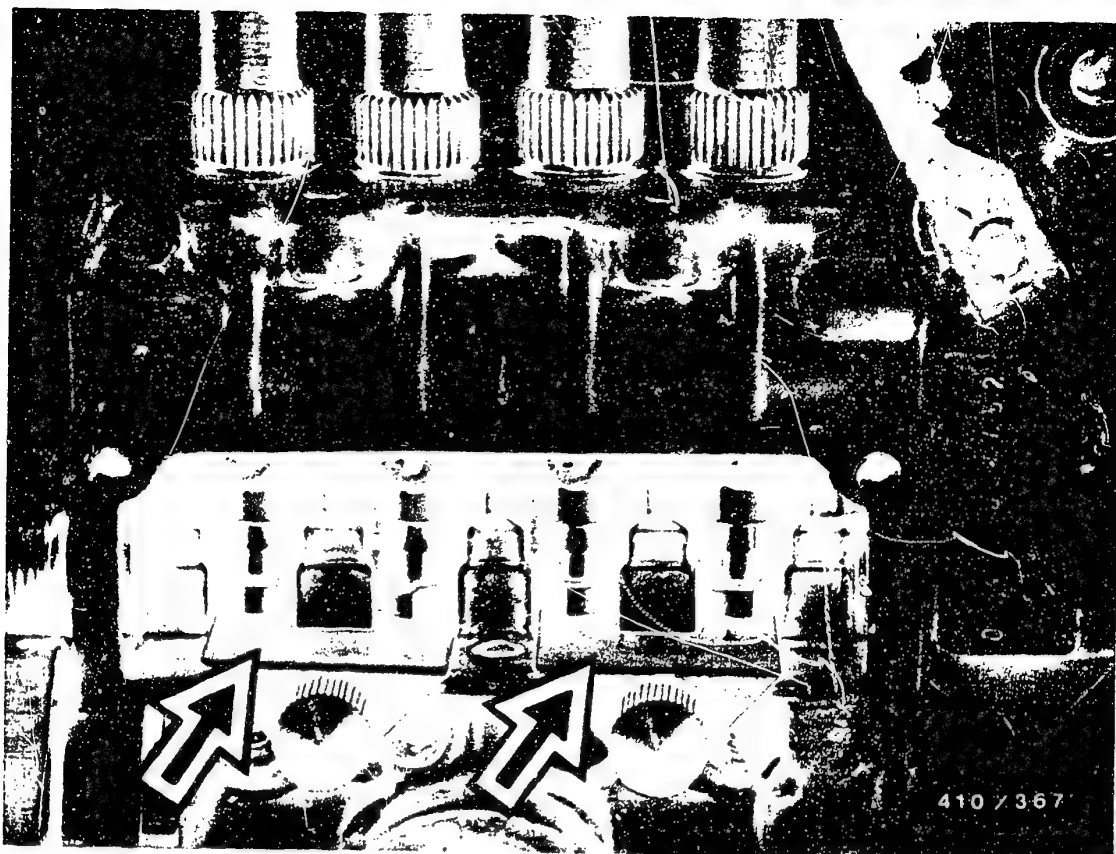
Tightening torques:

Delivery-valve holder with serration

15-25-30 + 5 Nm

Delivery-valve holder with hexagon

30-0-30-0-30 + 5 Nm



11.2 Testing suction gallery for leaks

Preparation:

Tilt pump housing by 90°.

Wet pump plunger with calibrating oil and insert in pump barrel with the help of plunger pliers KDEP 2915. Test pump plunger for freedom of movement.

If plunger does not move freely, remove plunger-and-barrel assembly and again mill (smooth) assembly seat.

Limit pump-plunger stroke by inserting holding plate KDEP 2913 (arrows).



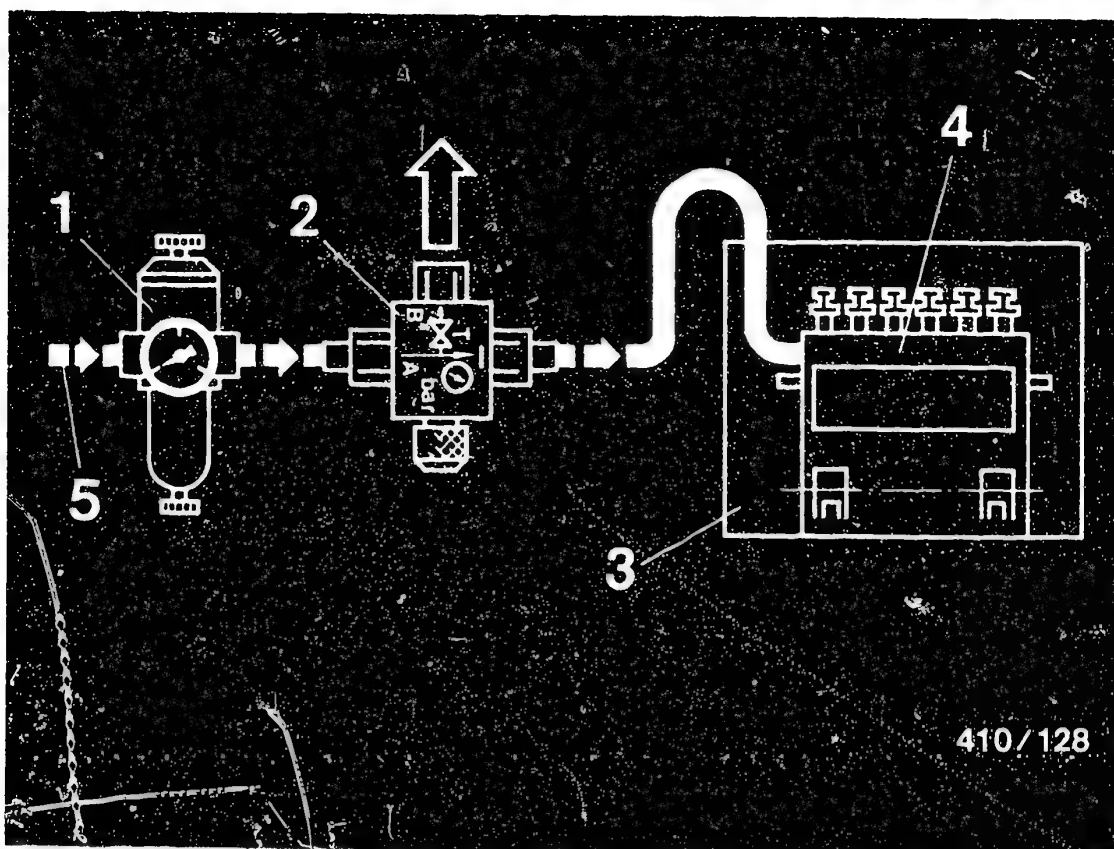
Take pump out of clamping support. Before immersion in calibrating oil, connect pump to the available compressed-air system via a pressure regulator with water separator. To achieve the required pressure drop during the leak test, insert directional-control valve KDJE-P-100/1 of pressure testing device KDJE-P 100 in the compressed-air supply line. Plug unused fuel inlet connections.

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Assembling injection pump

PES..M.., 0 410 ..





- 1 = Pressure regulator with 0..6 bar pressure gauge and water separator
- 2 = Directional-control valve KDJE-100/1
- 3 = Immersion tank with calibrating oil
- 4 = Injection pump
- 5 = Compressed air

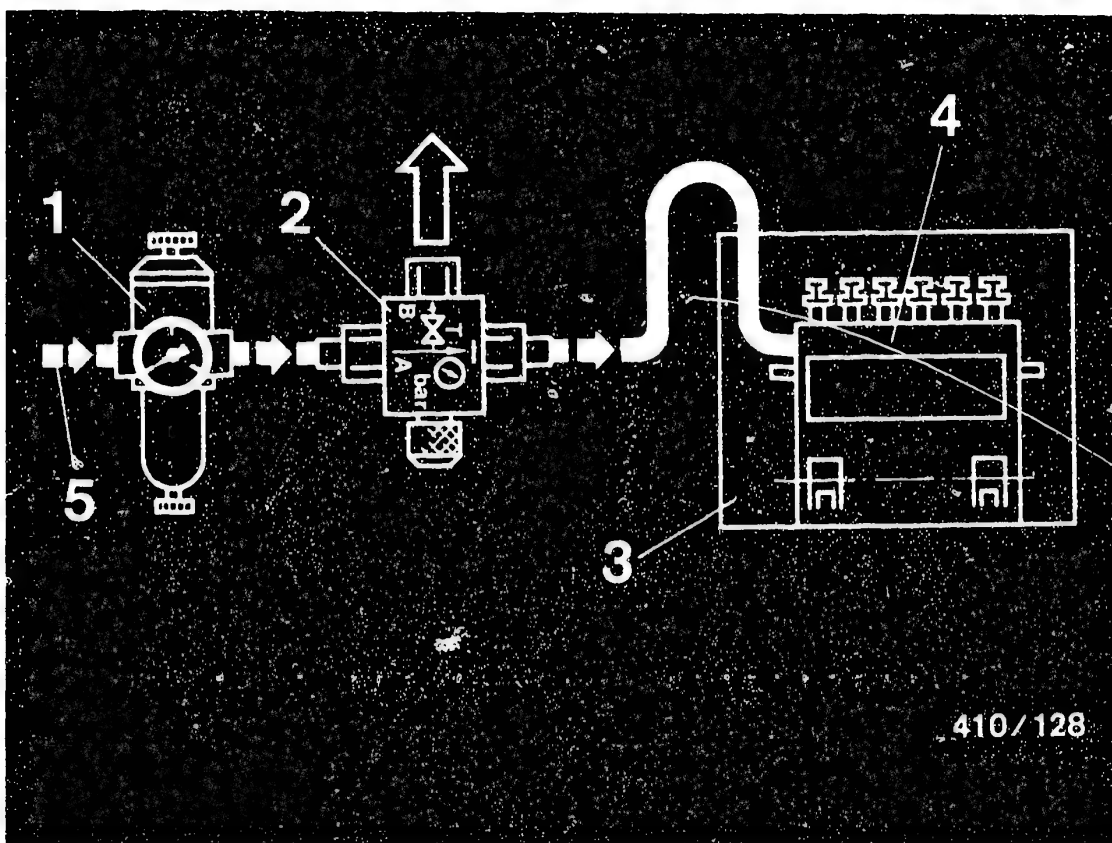
Suction gallery test

Immerse housing vertically in test bath. However, make sure that the calibrating oil does not wash over the openings of the delivery-valve holders.

Tilt the pump only for the purpose of localizing a leak in the housing.

There must be no leakage in the area of the suction gallery. Pay particular attention to the sealing of the assembly seats and O-ring seals. This does not apply to leakage between assembly cylinders and plungers.





- 1 = Pressure regulator with 0...6 bar pressure gauge and water separator
- 2 = Directional-control valve KDJE-P 100/1
- 3 = Immersion tank with calibrating oil
- 4 = Injection pump
- 5 = Compressed air

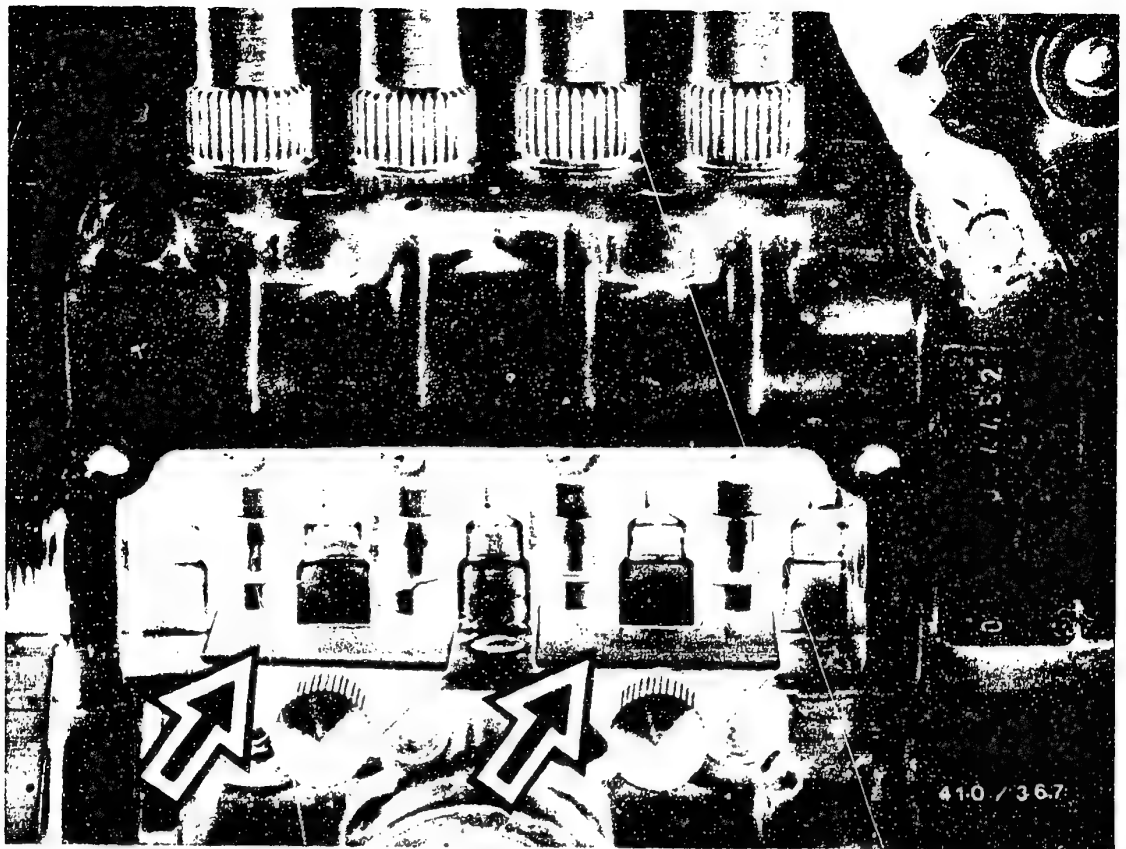
Test duration and pressure:
4 minutes at 5 bar

If an assembly seat shows leakage, unscrew assembly-valve holder, remove pump barrel, and remill (smooth) assembly seat with hand miller KDEP 2956, and repeat leak test.

Note:

In order to prevent skin irritation, before carrying out this test rub skin-protection cream into the hands, and wash with soap and water after completion of the test.





Remove compressed-air connection on pump housing.
Affix pump to clamping support.

Remove holding plate KDEP 2913 (arrows).

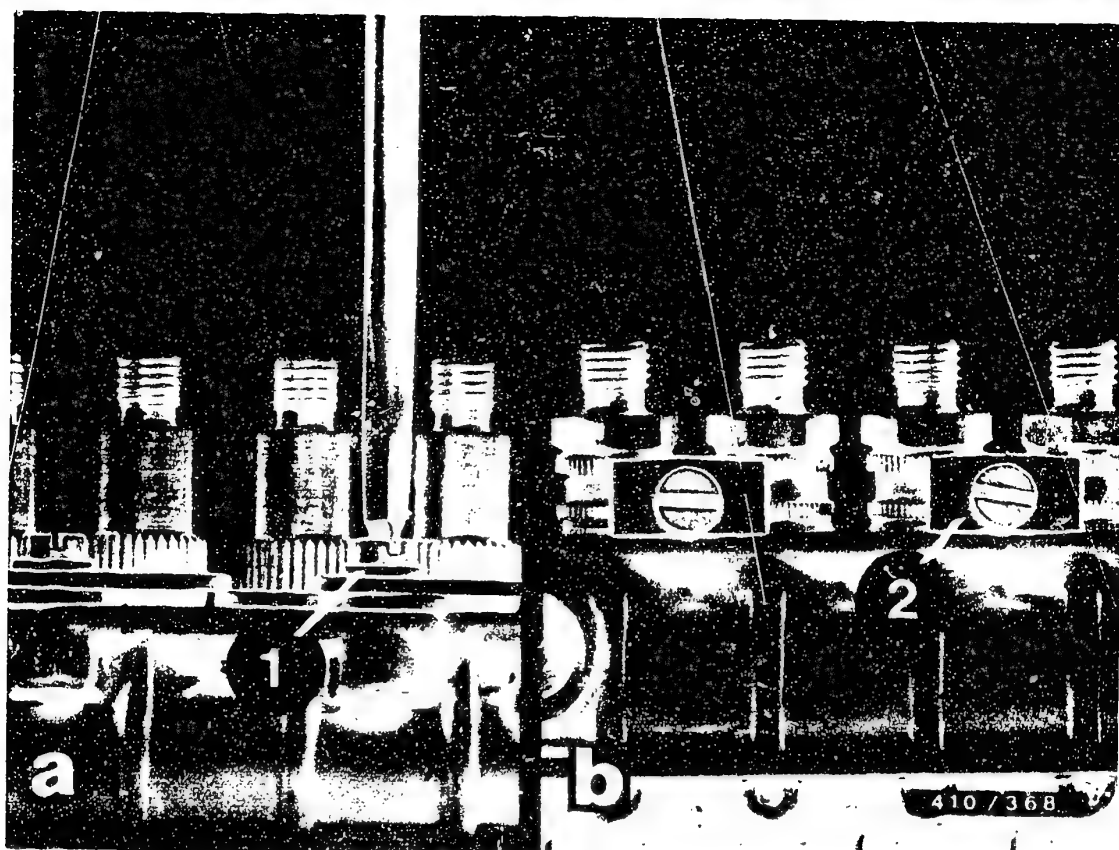
Use plunger pliers to pull pump plungers out of pump barrels, and lay in proper parts board of the barrel assembly.

D17

Assembling injection pump

PES..M., 0 410 ..



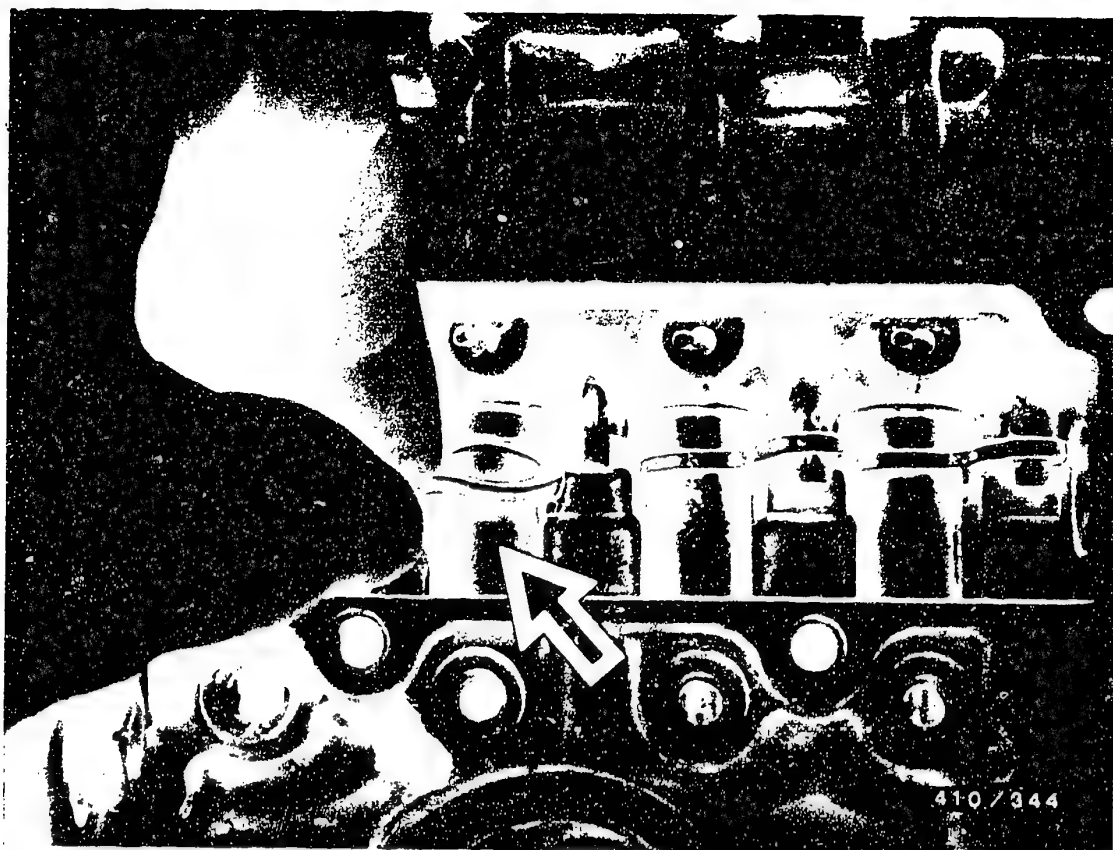


1 = Support plate

2 = Clamping jaws

Mount support plate (see illustration) or clamping jaws and tighten to 7...9 Nm.

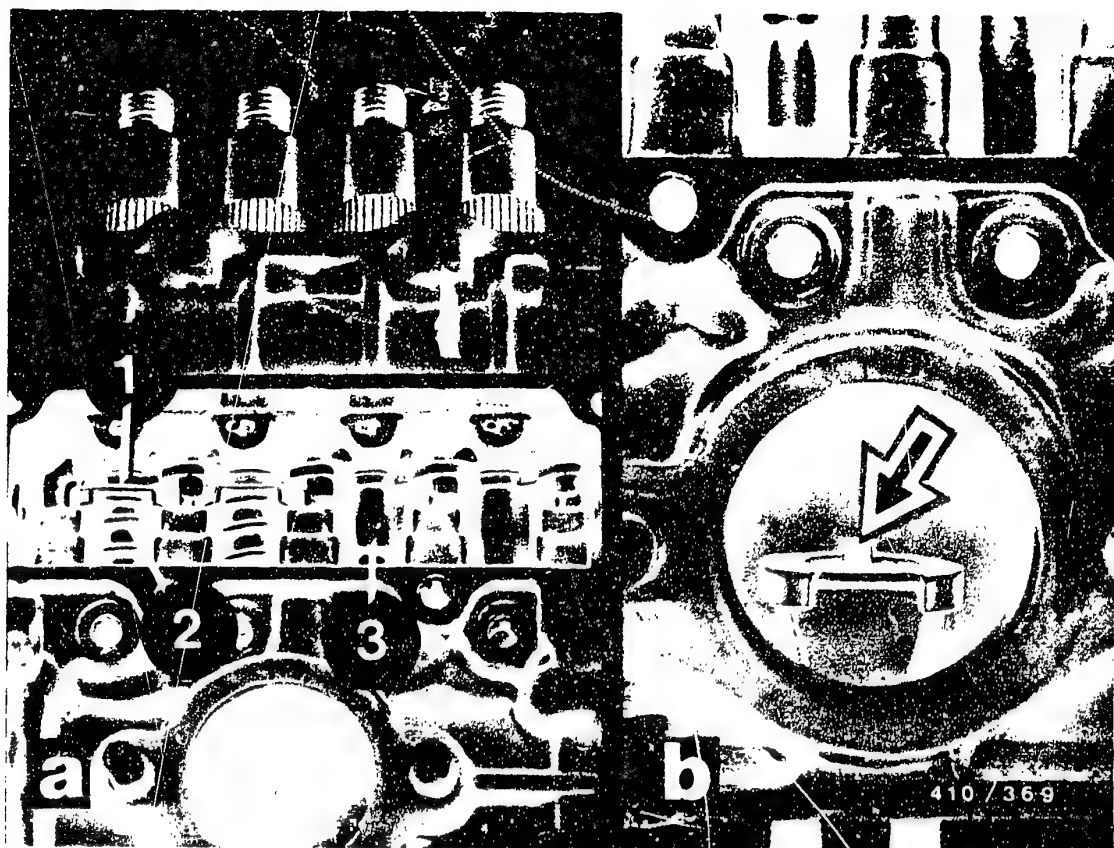




11.3 Installing control sleeves

Guide control sleeves (illustration, arrow) through spring chamber into tappet guide and push up over the stem of the pump barrel.





- 1 = Upper spring seat 3 = Control sleeve
2 = Plunger return spring

11.4 Inserting spring seats and plunger return springs

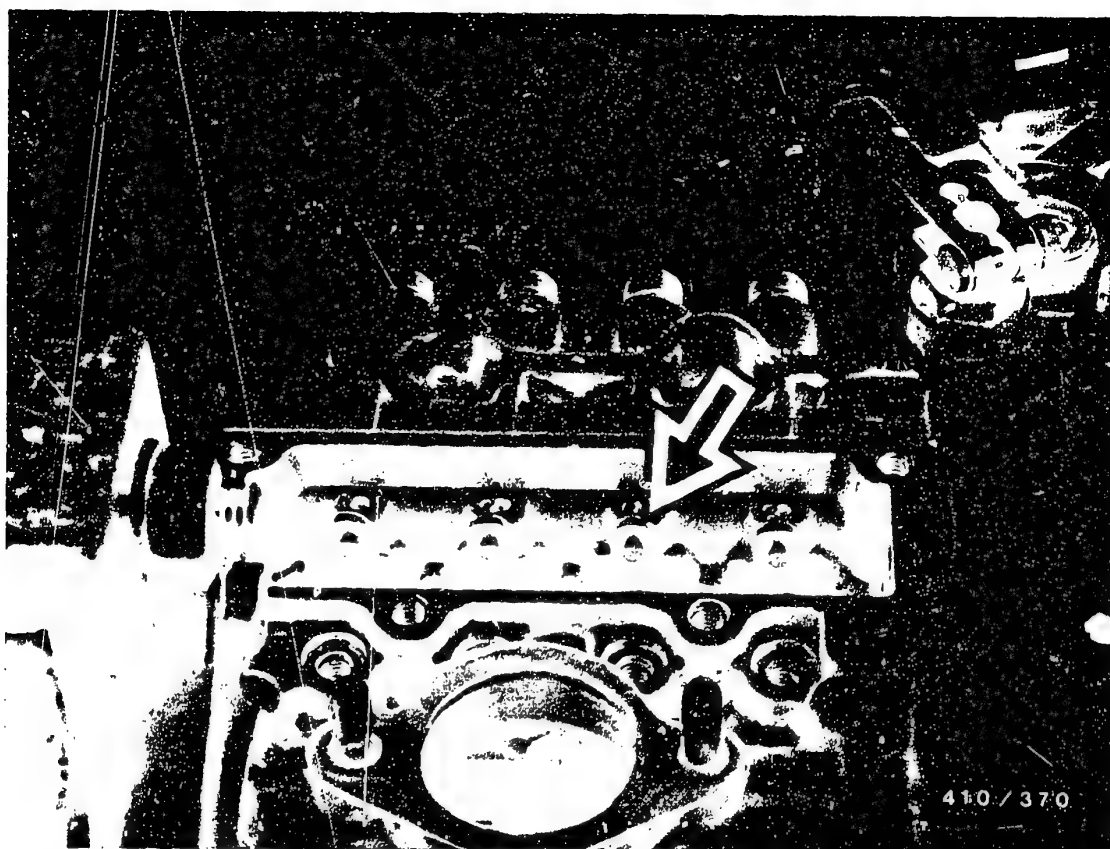
Push upper spring seat with plunger spring onto control sleeve without tilting (fig. a).

Note:

Install spring seat so that the lug (arrow) fits into the housing recess.

The ground surface of the spring seat will then face forward.





Tilt pump

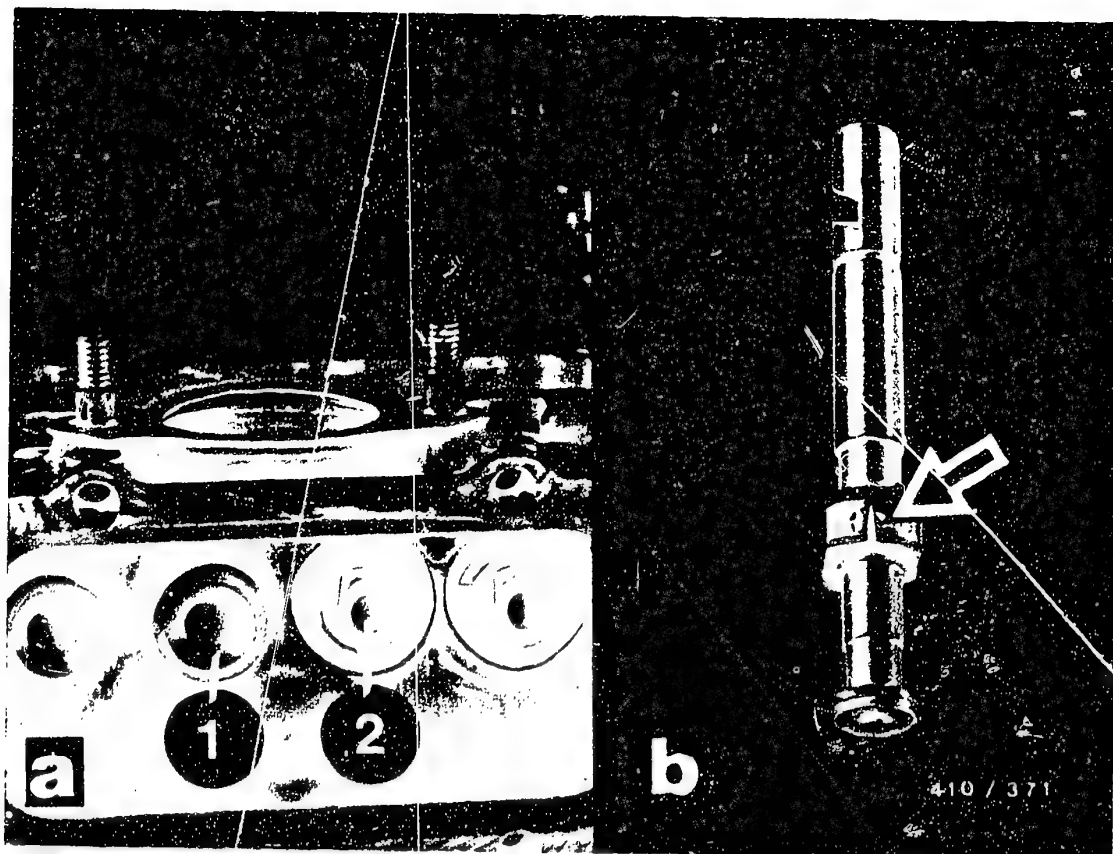
Delivery-valve holders point downwards.
Turn control sleeves so that the linkage levers
(arrow) face forwards.

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Assembling injection pump

PES..M.., 0 410 ..





1 = Lower spring seat 2 = Plunger base

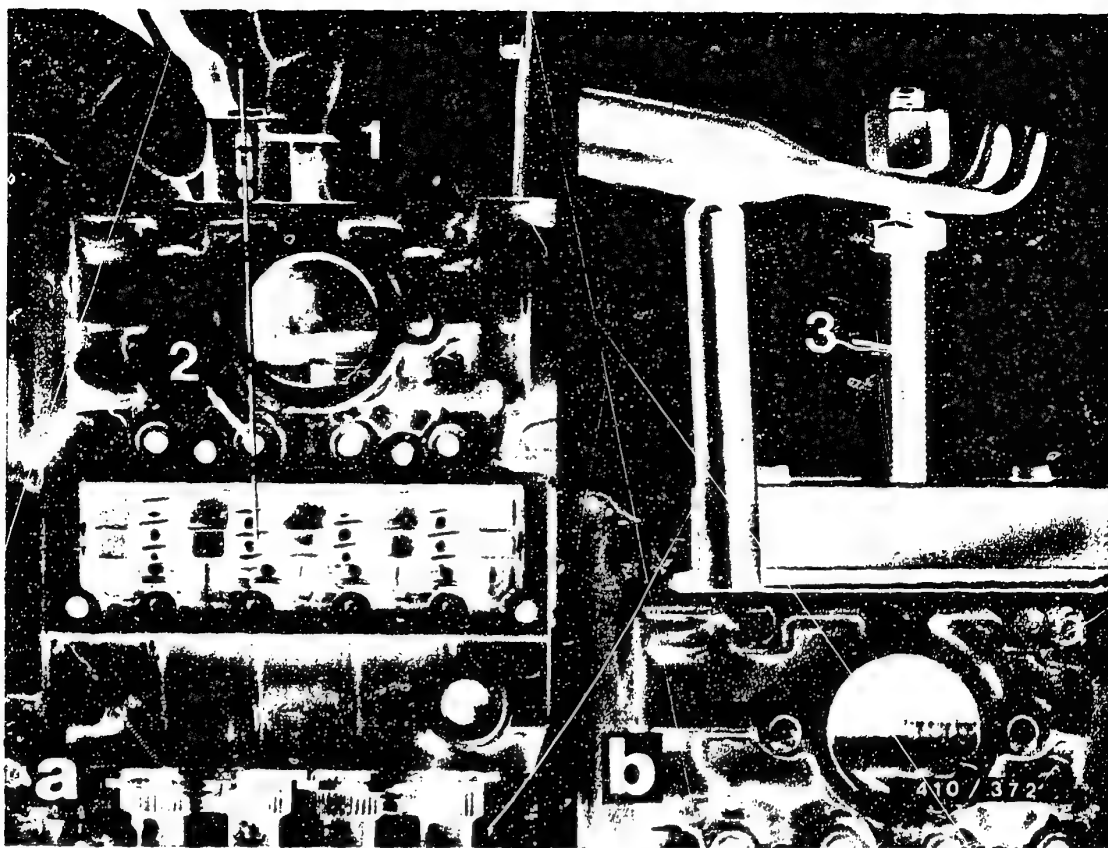
11.5 Installing pump plunger with lower valve seat

Wet pump plunger with calibrating oil and insert in pump barrel using plunger pliers KDEP 2915. Check pump plunger for freedom of movement. Set lower valve seat on plunger base. Guide plunger and spring seat together into pump barrel.

Note:

The groove on the plunger control arm (fig. b, arrow) must face the spring-chamber cover (upwards) during insertion.





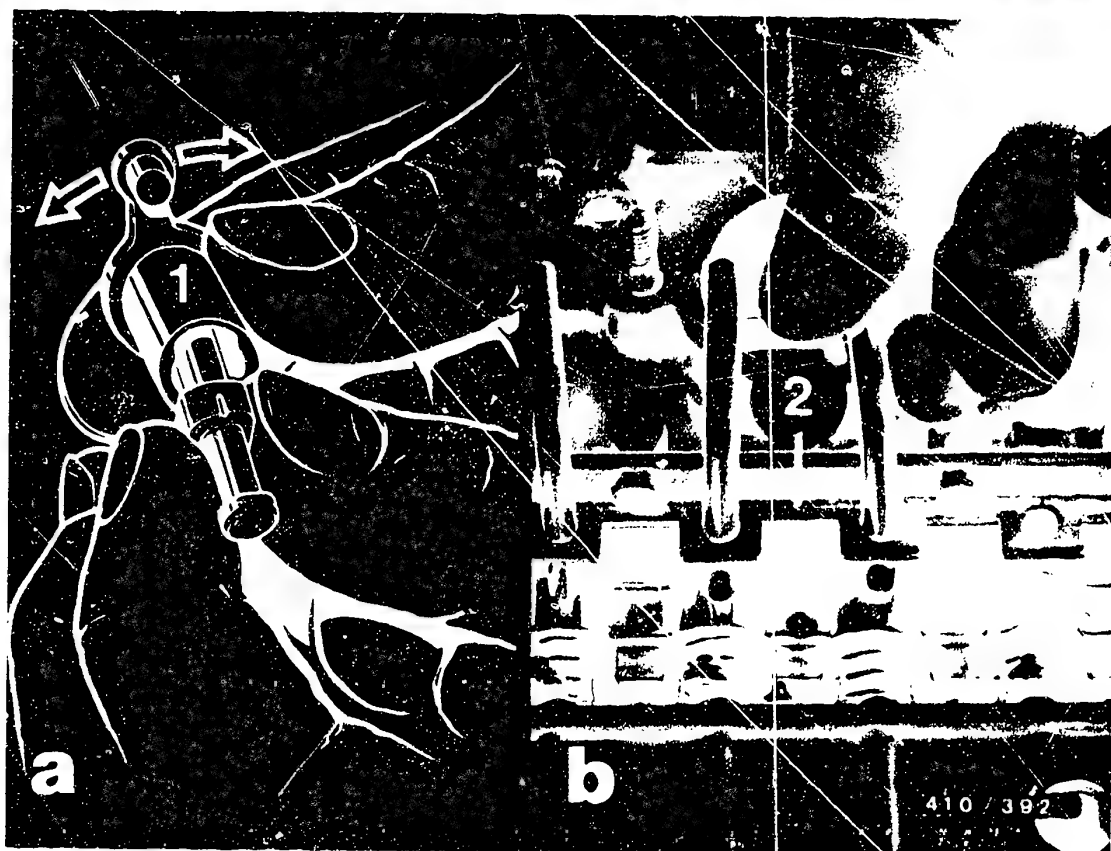
- 1 = Roller-tappet guide groove 3 = Mounting device
2 = Locating hole

11.6 Inserting roller tappets

Insert roller tappet in pump housing so that the roller-tappet guide groove faces the locating hole of the guide screw.

Mount mounting device KDEP 1505.





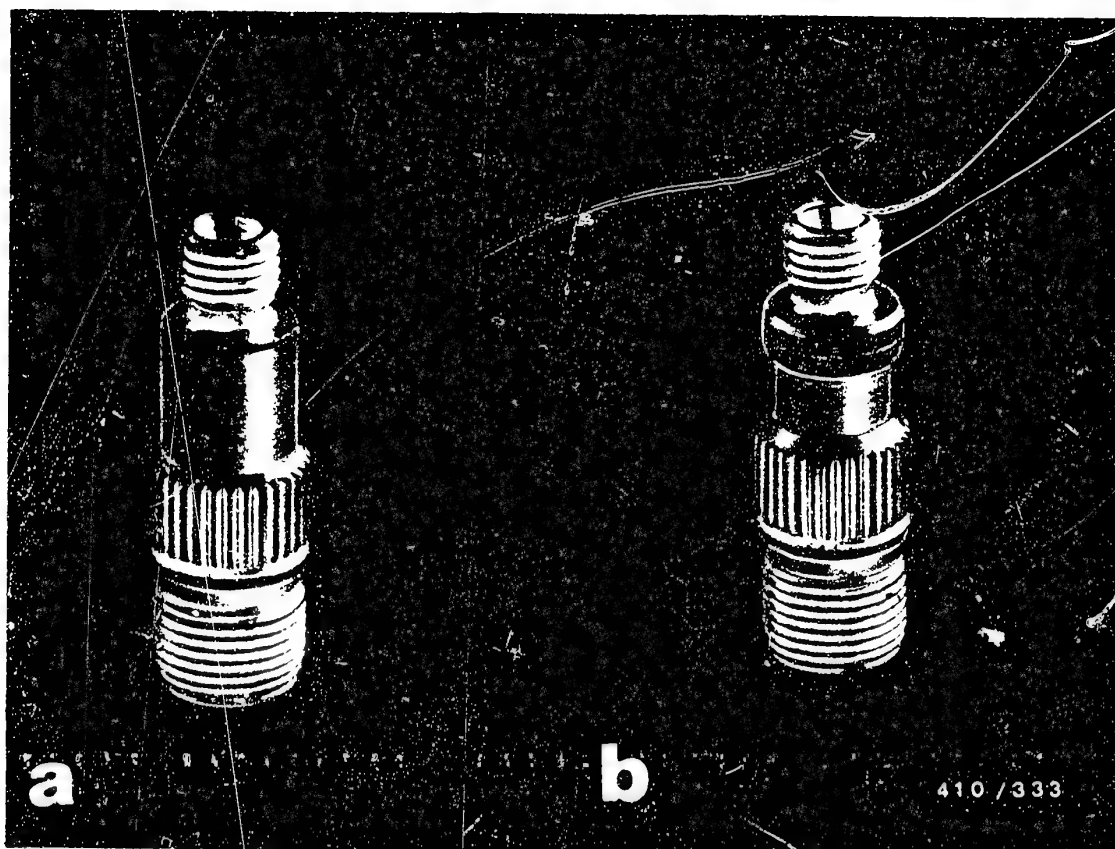
1 = Linkage lever

2 = Tappet holding device

Insert tappet holding device. Using thrust member, push roller tappet downwards with slight vibrations. While doing this, move linkage lever back and forth slightly until plunger control arm catches in linkage lever. In this position, press roller tappet into TDC position.

Insert tappet holders into holding device as appropriate for pump version and fix roller tappets in TDC position.





- Insert tappet holders

On pumps without a collar on the delivery-valve holder (fig. a), use tappet holders with large exterior diameter.

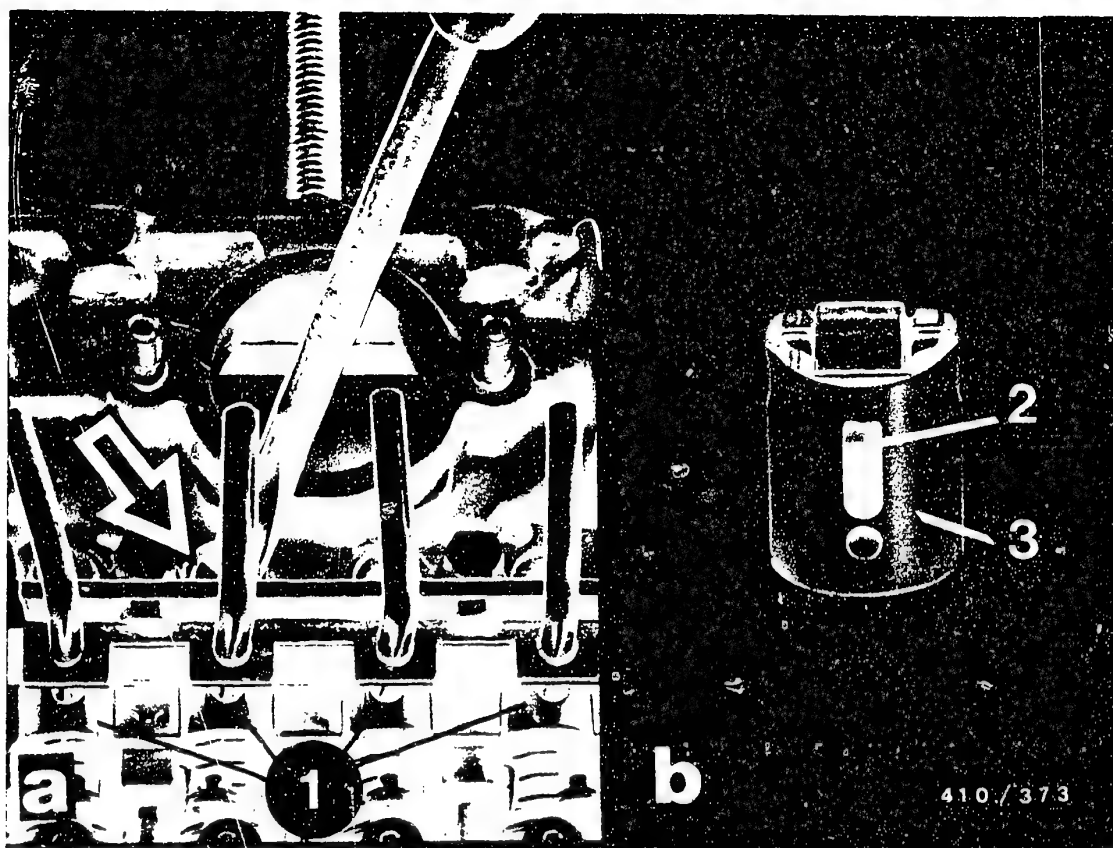
On pumps with collar or hex nut (fig. b), use tappet holders with small outside diameter.

E1

Assembling injection pump

PES..M., 0 410 ..





1 = Control sleeves
2 = Guide groove

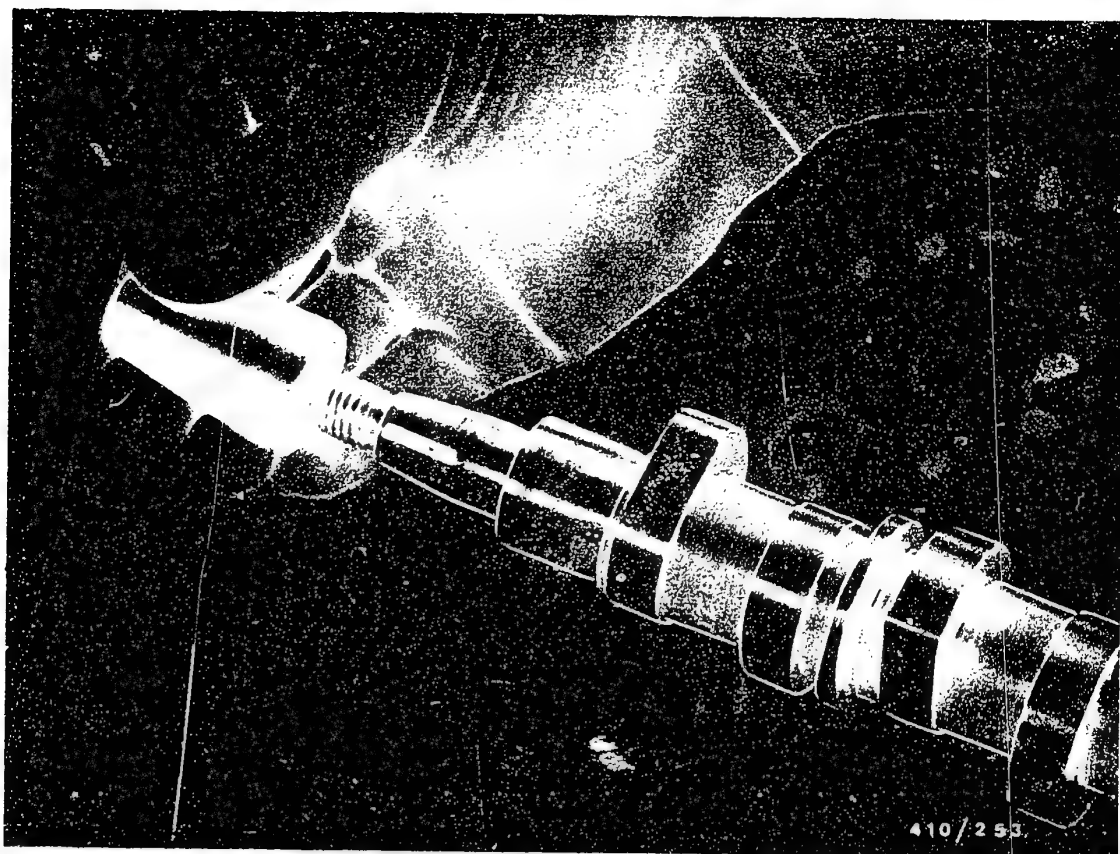
3 = Roller-tappet body

Screw in roller-tappet locating screws (arrow) (use micro-encapsulated screws per service-parts list).

Note:

When screwing in the roller-tappet locating screws, make sure that the locating screw fits into the guide groove and does not press on the roller-tappet body (danger of breakage).

Check control sleeves for ease of movement and discernible vertical play.



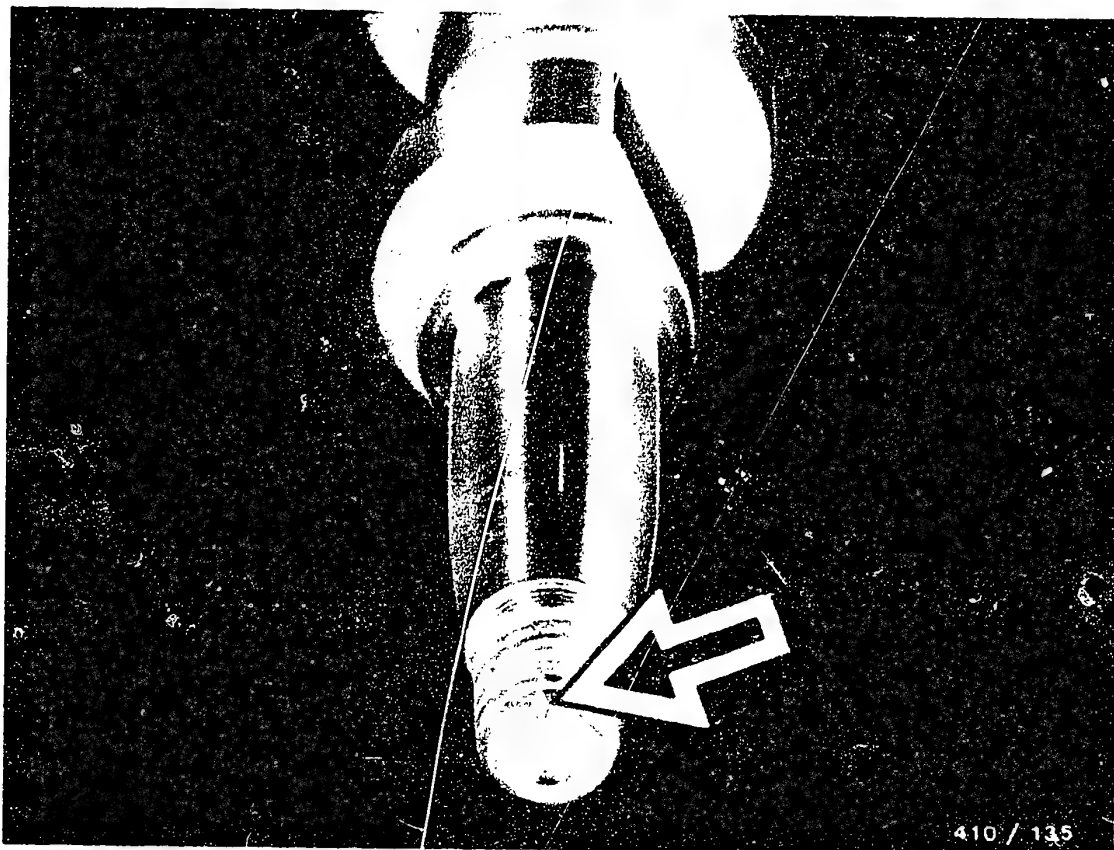
11.7 Installing camshaft on pumps without FBG

Mount bearing end plate.

Remove injection pump from clamping support KDEP 2919.

Screw mounting sleeve KDEP 2874 onto drive-side cone to protect radial-lip-type oil seal.





Before installing camshaft, note groove marking which is found only on one end face of the two threaded shaft ends (see illustration, arrow).

The installation position of the marking provides for the correct cam sequence, and is determined by the assembly number of the injection pump.

Note:

With cones having differing diameters, the larger diameter will always face the drive side.

E4

Assembling injection pump

PES..M., 0 410 ..



Explanation of assembly numbers

Supply pump (mounting side and number)																	
Mounted on:										Pump sides							
without		1 each		2 each		1 each		2 each		1 each		2 each		Governor	Timing device	Plunger control edge	
Shaft position (designated by grooves on shaft end)														on pump side	on pump side		
1	2	1	2	1	2	1	2	1	2	1	2	1	2	(1)		on bottom	on top
100	200	300	400	500	600	700	800	900	1000					-	-		
101	201	301	401	501	601	701	801	901	1001					-	1		
102	202	302	402	502	602									-	2	left-handed	right-handed
110	210	310	410	510	610									1	-		
112	212	312	412	512	612									1	2		
120	220	320	420	520	620	720	820	920	1020	1320	1520			2	-		
121	221	321	421	521	621	721	821	921	1021					2	1	right-handed	left-handed

Example: 421

Injection pump with shaft position 2 and a supply pump on pump side 3, governor on pump side 2 and timing device on pump side 1.

On 2-cylinder injection pumps of size A, the first 3../. = 90° or 270° in shaft position 1;

4../. = 180° in shaft position 2.

A code number representing the possibility of mounting a supply pump can be added to the assembly number, e.g.:

../3 = With mounting opening for supply pump, closed by cover (without supply pump).

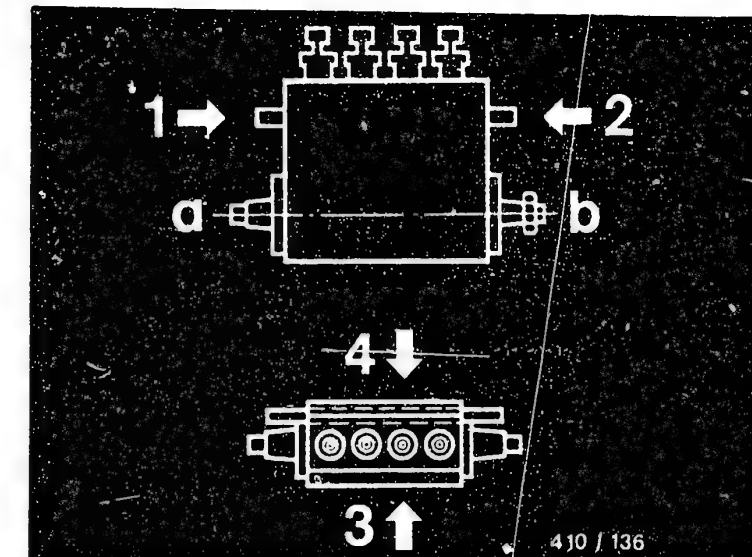
../4 = With 2 mounting openings, on left with supply pump, on right closed with cover.

../5 = With 2 mounting openings, left closed with cover, right having supply pump.

../6 = With 2 mounting openings, both closed with cover (without supply pump).

../7 = With 2 mounting openings each on sides 3 and 4, right opening closed with cover.

1) The entire injection assembly is turned by 180° with assembly numbers beginning with odd characters (300, 500, 700 etc.) with governor position 2.



3.4 = With pump size M, when cover at front and control rod at rear.

a = Shaft position 1 (here with grooves on shaft end)

b = Shaft position 2 (here with grooves on shaft end)

E5

Assembling injection pump

PES..M.., 0 410 ..

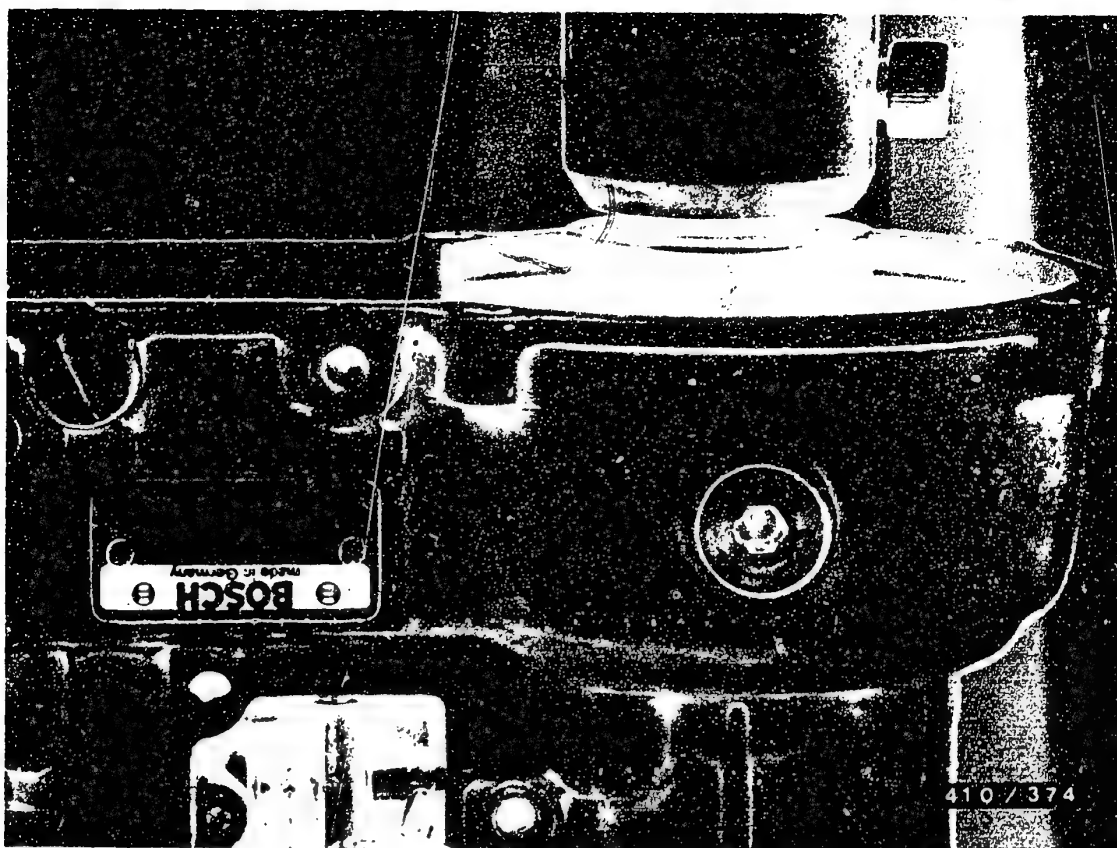


E6

Assembling injection pump

PES..M.., 0 410 ..





Insert camshaft screw guide sleeve (found in parts set of press-in tool KDEP 1049) onto camshaft on governor side.

Push press-in sleeve over guide sleeve and press deep-groove ball bearing into pump housing to the stop under an arbor press.

Note:

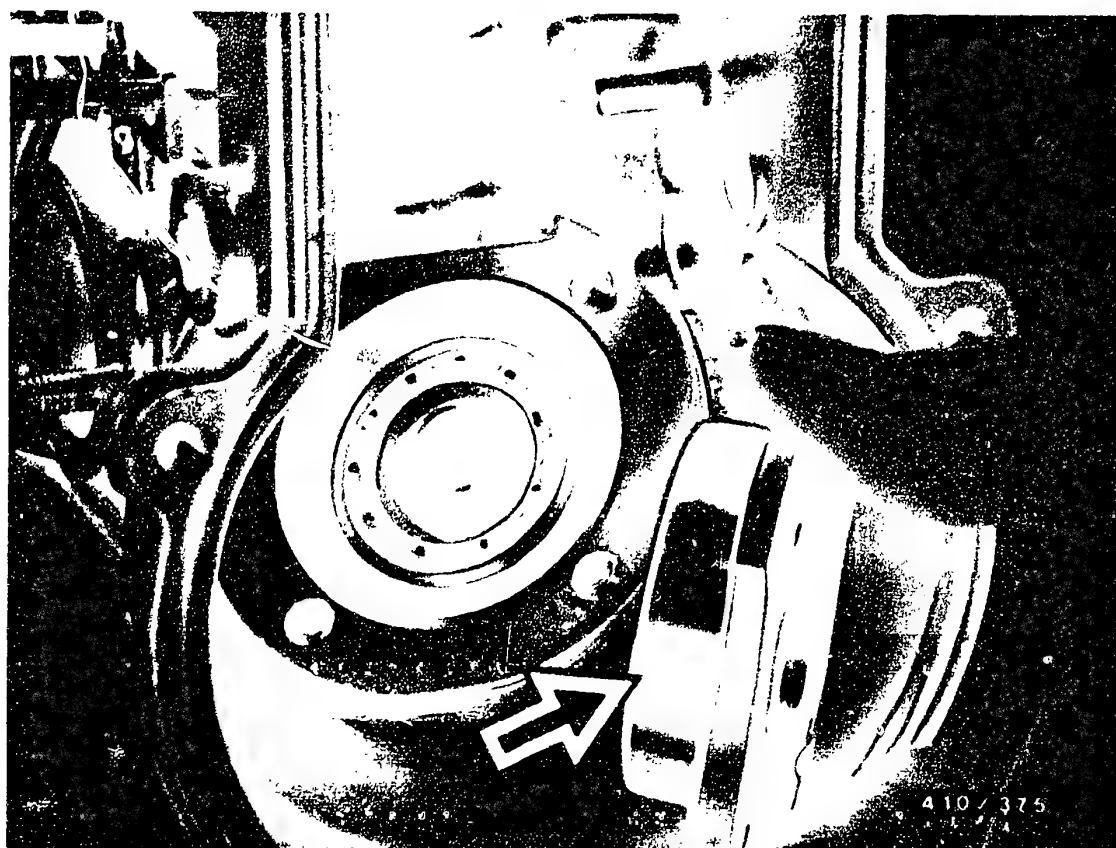
Apply pressure only to the outer race of the deep-groove ball bearing.

E7

Assembling injection pump

PES..M.., 0 410 ..





Arrow = Governor-side bearing and plate

11.8 Installing camshaft on pumps with pneumatic governor

Mount bearing end plate on drive side. Insert camshaft (pay attention to installation position).

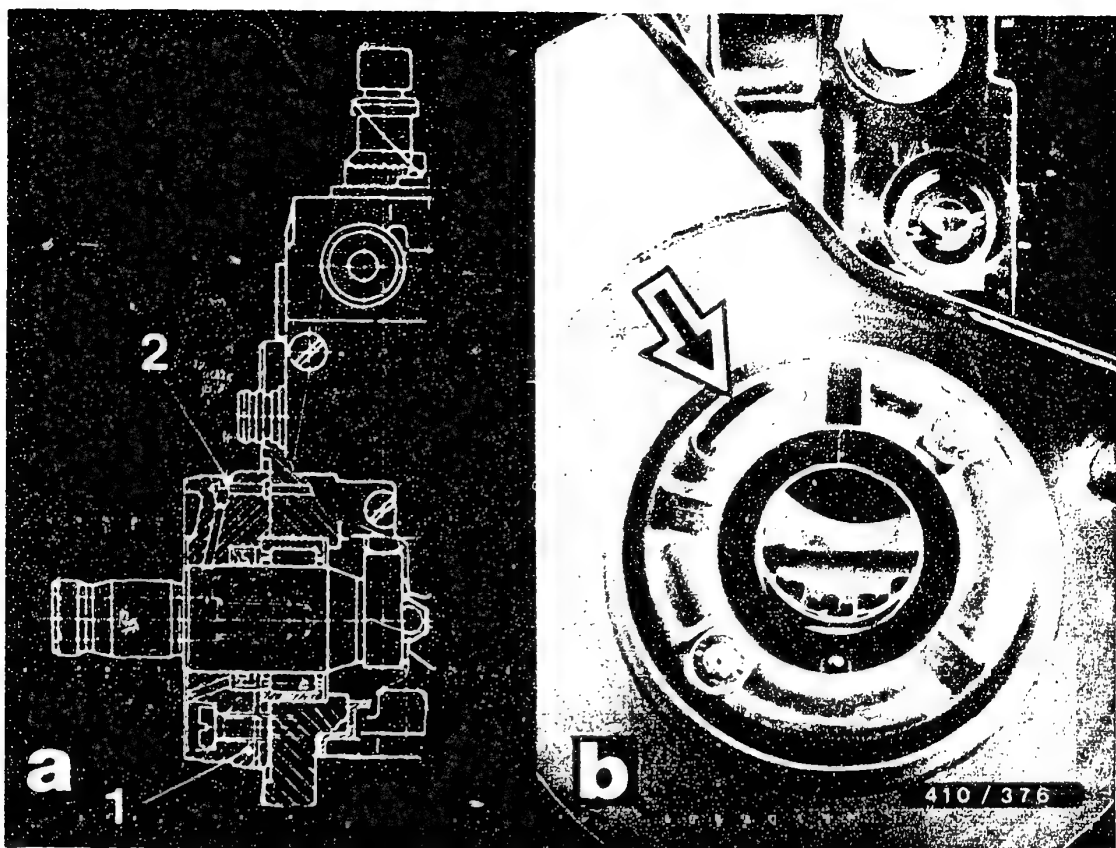
Mount governor-side bearing end plate. Tighten fastening screws to 7...9 Nm.

E8

Assembling injection pump

PES..M., 0 410 ..





1 = Bearing end plate 2 = Lubricating hole

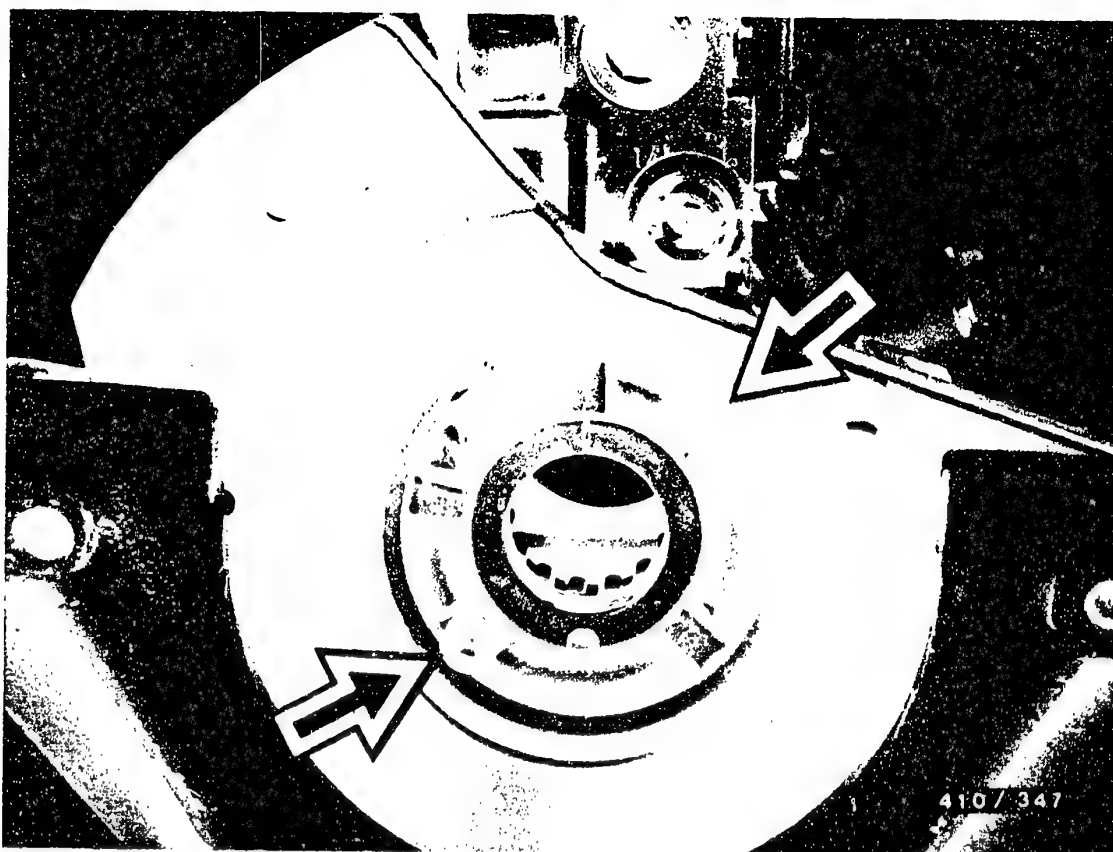
11.9 Installing camshaft on pumps with FBG system

Mount drive-side bearing end plate on pumps with FBG system.

Note:

When mounting the bearing end plate, make sure that the ring gap lies on the upper left as viewed towards the drive (arrow). If the end plate is incorrectly mounted, lubrication circulation to the pump and timing device is interrupted.





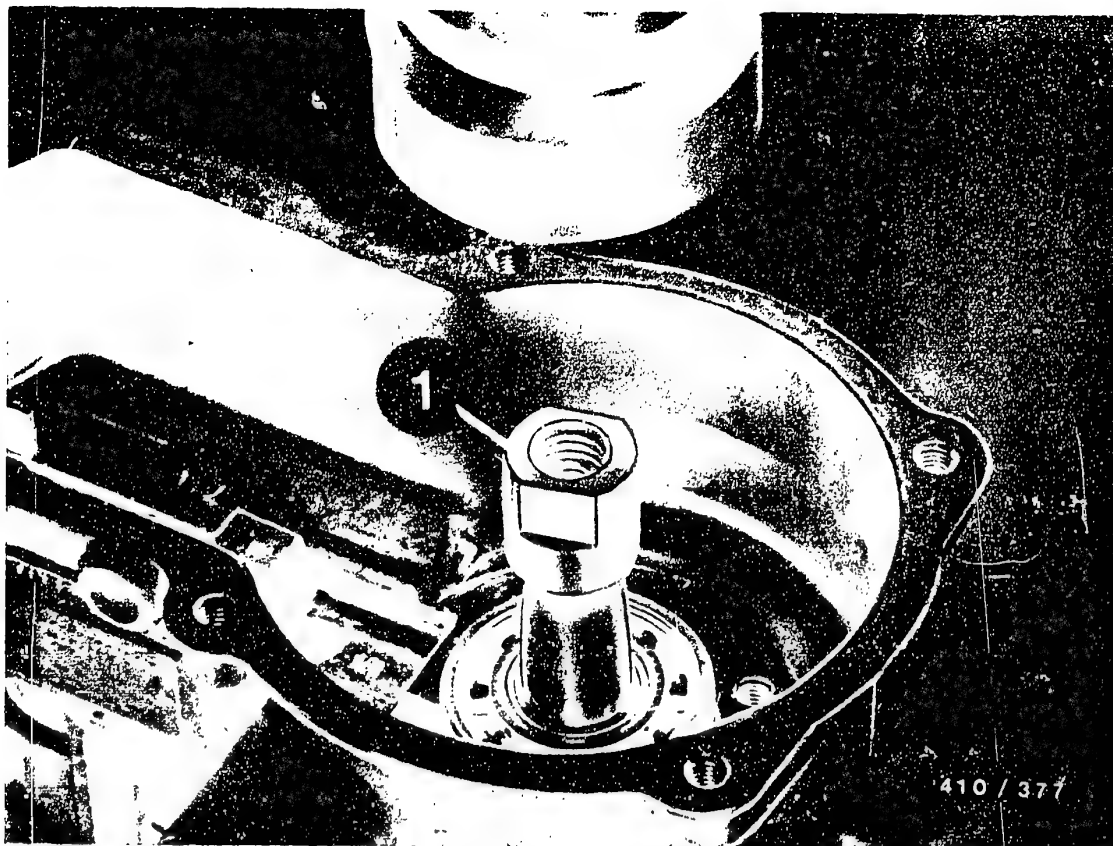
Tighten bearing end plate fastening screws (see illustration, arrow) to 7 - 9 Nm.

E10

Assembling injection pump

PES..M.., 0 410 ..





1 = Guide sleeve

Remove injection pump from clamping support KDEP 2919. Insert camshaft.

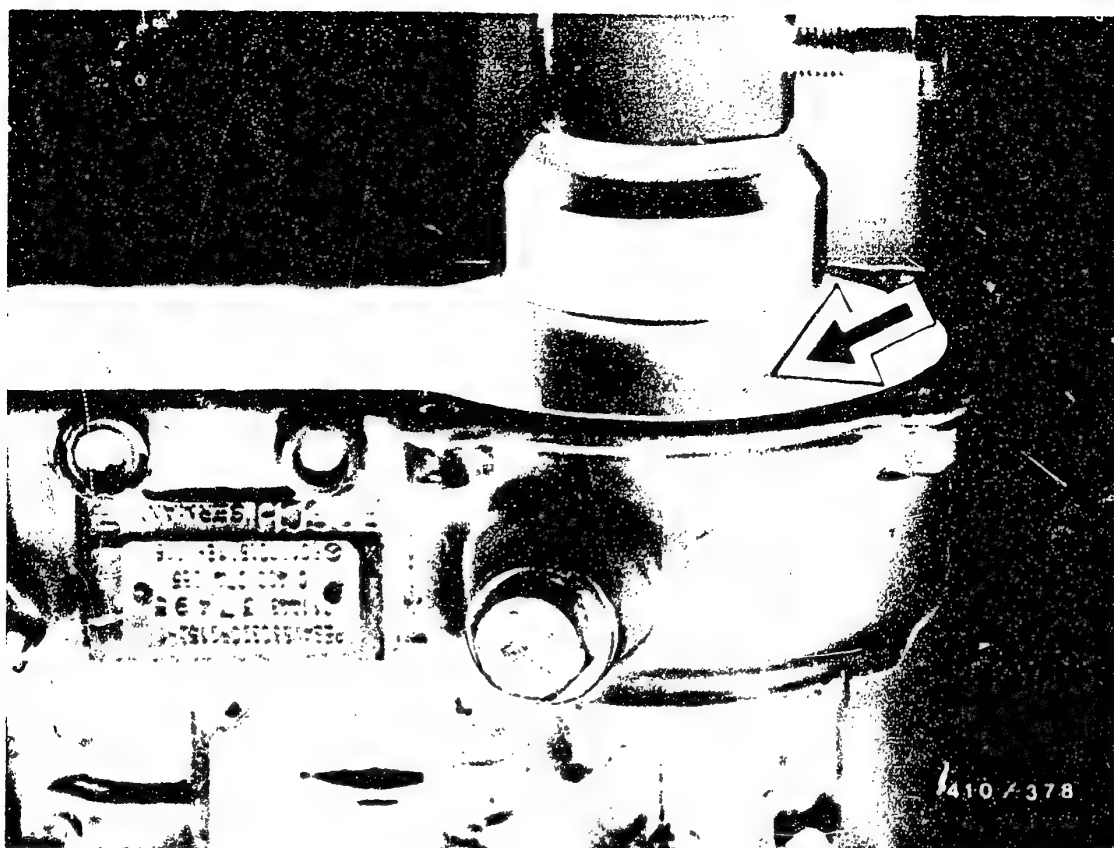
Screw guide sleeve (found in parts set of press-in tool KDEP 1049) onto camshaft on governor side.

E11

Assembling injection pump

PES..M.., 0 410 ..



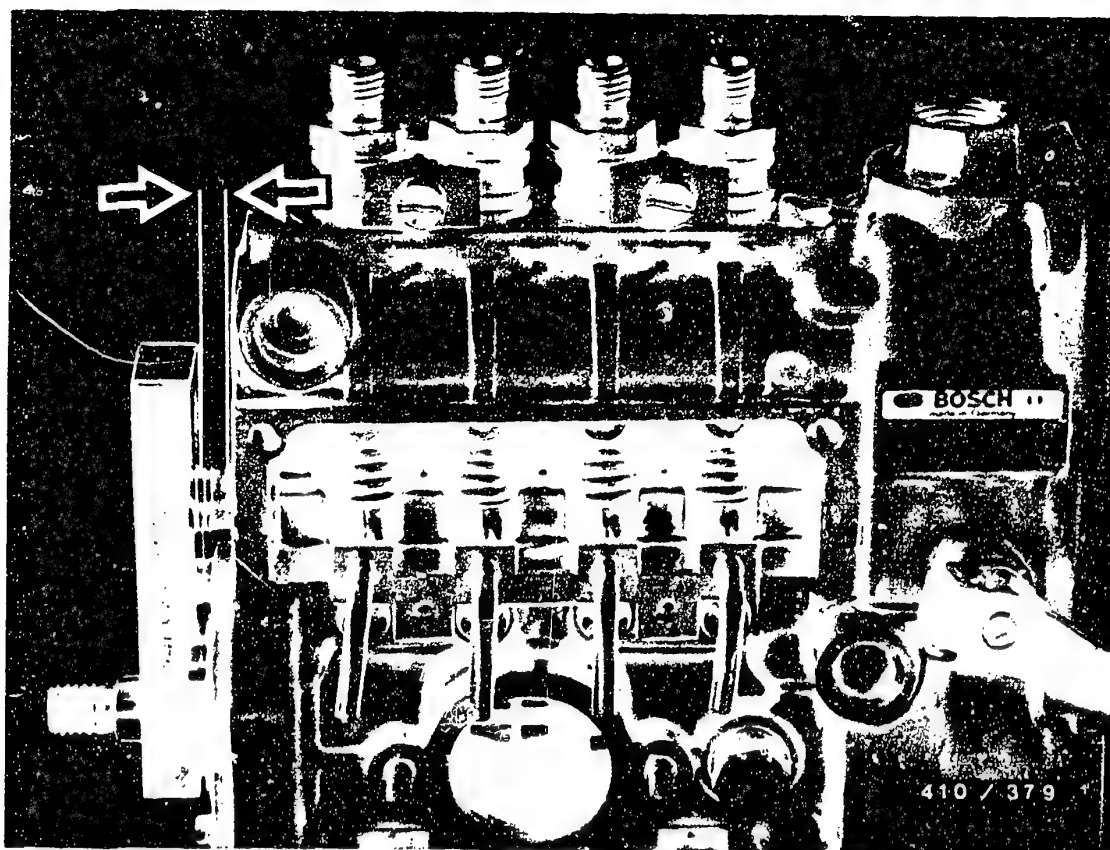


Push press-in sleeve over guide sleeve and press deep-groove ball bearing into pump housing to stop under arbor press.

Note:

Apply pressure only to the outer race of the deep-groove bearing.





11.10 Checking and adjusting the projection and axial play of the camshaft (only on M pumps with pneumatic governor).

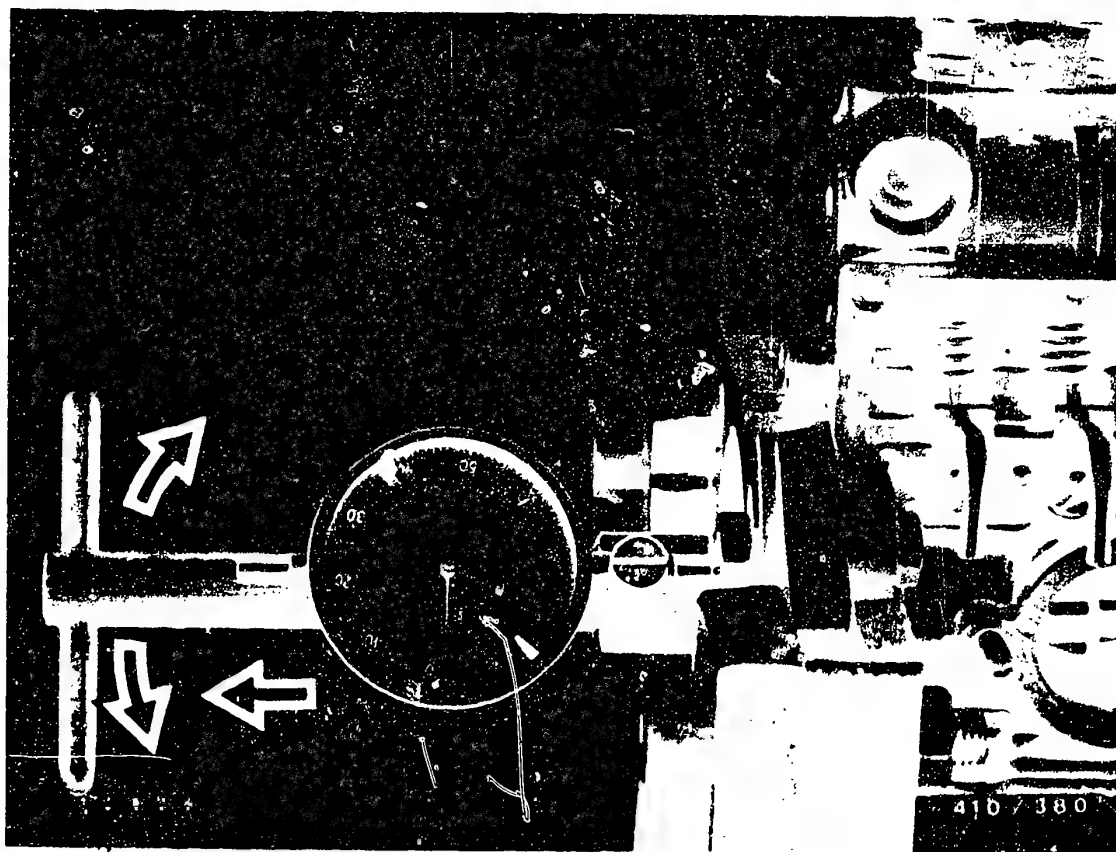
Push fluid-level gauge KDEP 2899 onto camshaft cone.
Use caliper gauge to measure distance from pump flange
(see illustration, arrows) and note down.

Nominal value: 9.5 ± 0.5 mm

Camshaft projection is adjusted by means of the shims
under the camshaft bearing.

Note:

The same shims are used to adjust the axial play of
the camshaft.



Checking camshaft axial play

Screw axial-play measuring device onto drive side.

Insert dial indicator into recess provided and pre-tension by 1 mm.

Pull camshaft axially with measuring device using short, quick turns (approx. 45°).

E14

Assembling injection pump

PES..M.., 0 410 ..



Release measuring device. Set dial indicator to "0".

Then, using the same turning motion, press camshaft axially and release at exactly the same point at which the dial gauge was set to "0".

Read axial play on dial indicator.

Nominal value:

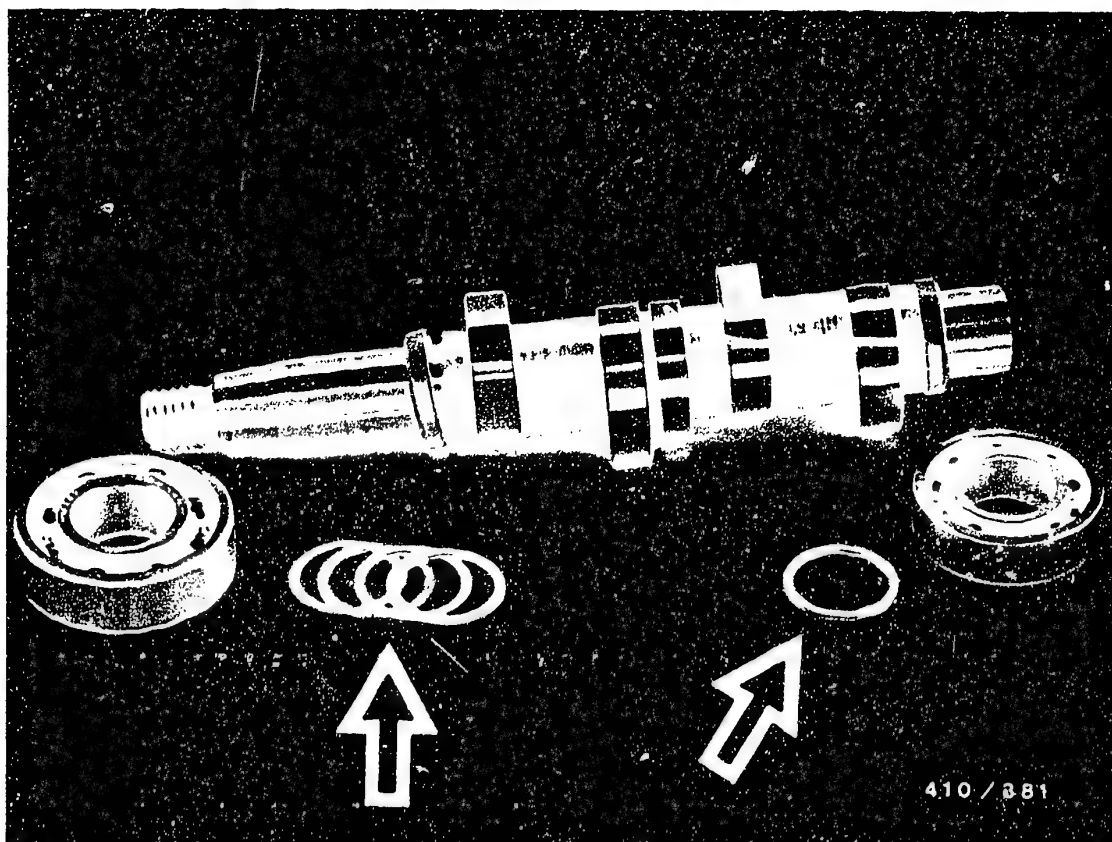
Deep-groove ball bearing 0.03 ... 0.13 mm

E15

Assembling injection pump

PES..M.., 0 410 ..





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If the measured values for camshaft projection and axial play are outside tolerances, remove the camshaft, press off the camshaft bearings and adjust the projection and/or axial play by changing the shims (see illustration, arrows).

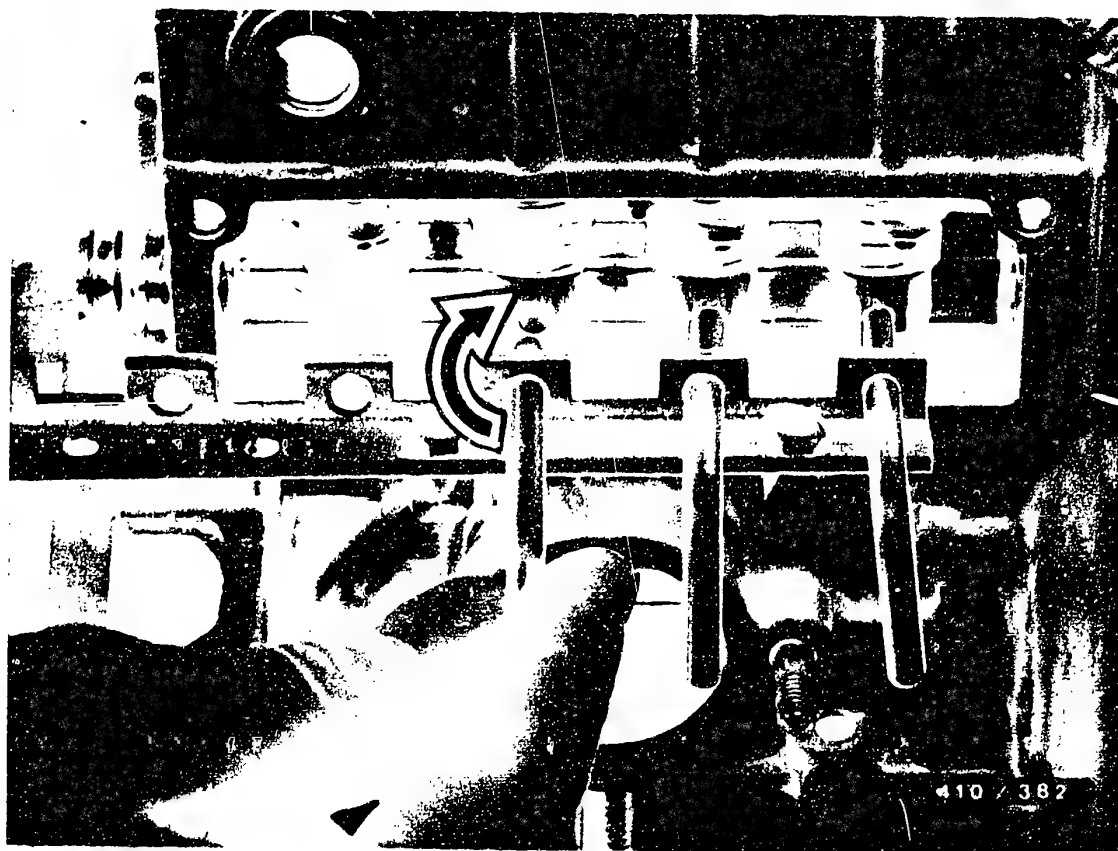
Repeat camshaft projection and axial-play testing.

E16

Assembling injection pump

PES..M.., 0 410 ..

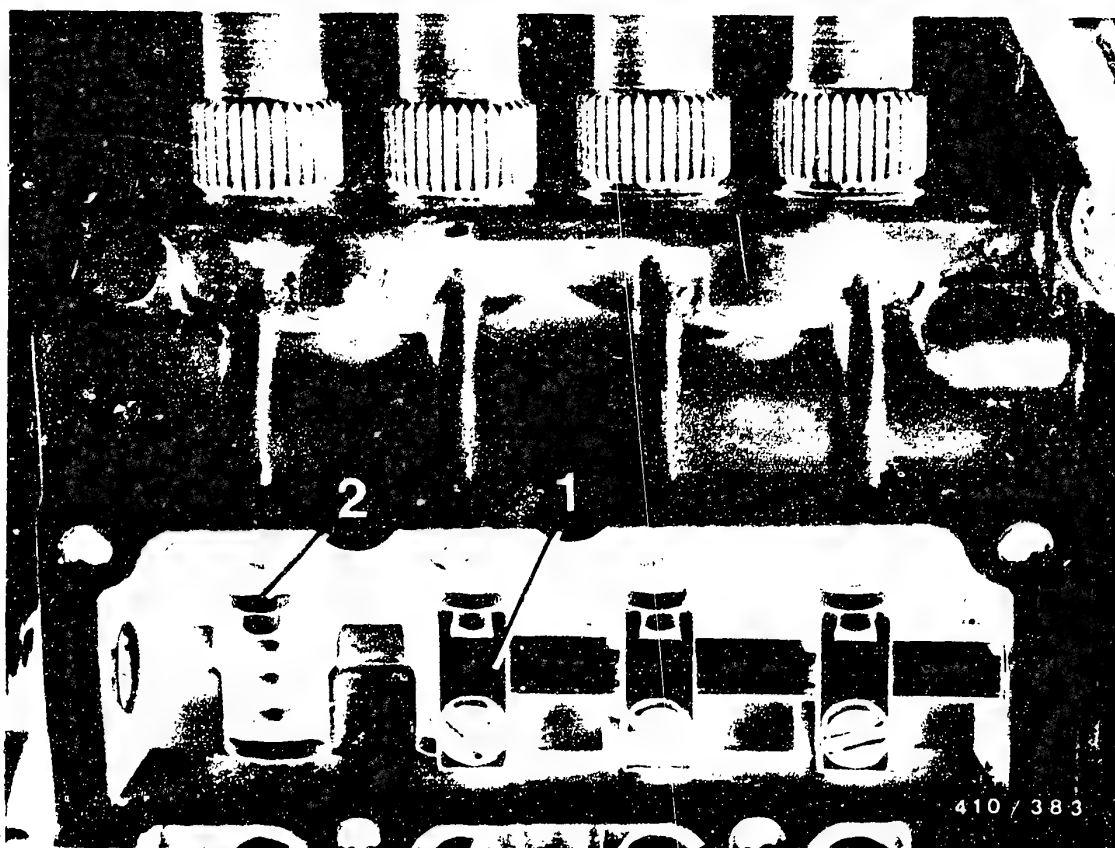




11.11 Removing tappet holders
Mount drive coupling.

Turn tappet holder by 180°.
Turn camshaft until cam lobe lifts roller tappet.
Remove tappet holder.





1 = Clamping pieces

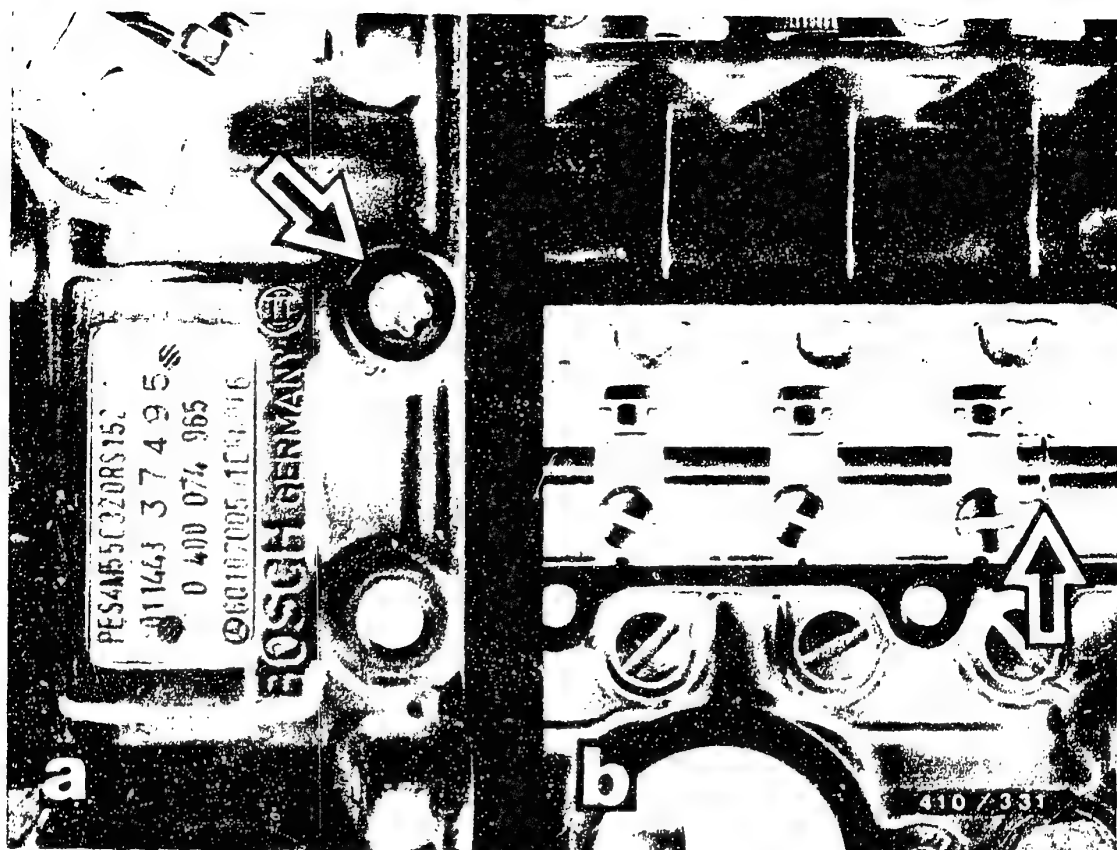
2 = Linkage lever

11.12 Installing control rod and clamping pieces

Insert support clamps individually (one after another) into linkage levers of control sleeves and bring into middle position (select support clamps and control sleeves per service-parts list).

Push control rod with play-compensating spring into pump housing.

Thread control rod through guide groove of individual clamping pieces.



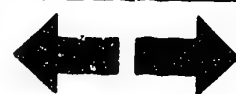
Install control-rod shutoff stop screw (fig. a, arrow).

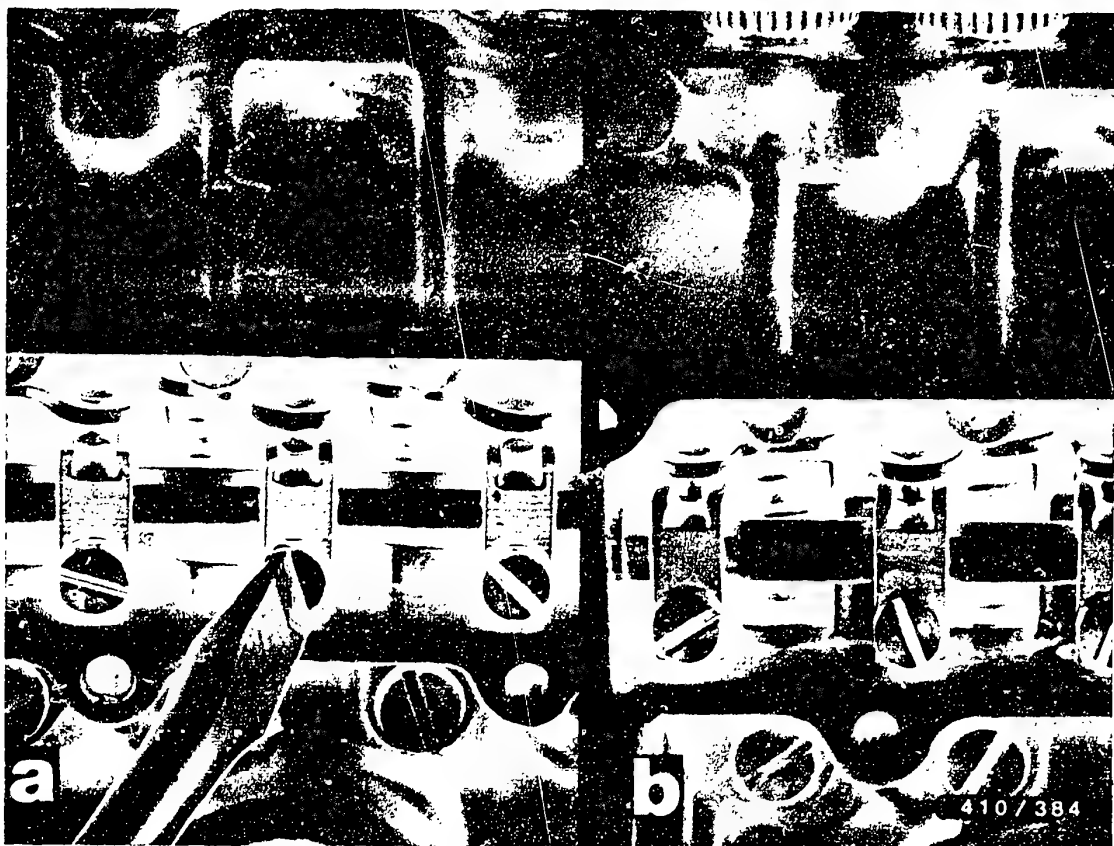
Note:

On pumps with pneumatic governor, use retaining ring as shutoff stop (fig. b, arrow).

Bring control rod into middle position.

Push clamping pieces on control rod to where linkage levers are vertical with respect to the control rod. Lightly tighten clamping pieces.





Test control rod for ease of movement and equal left/right stop.

At control-rod position "Start/Stop", check that:

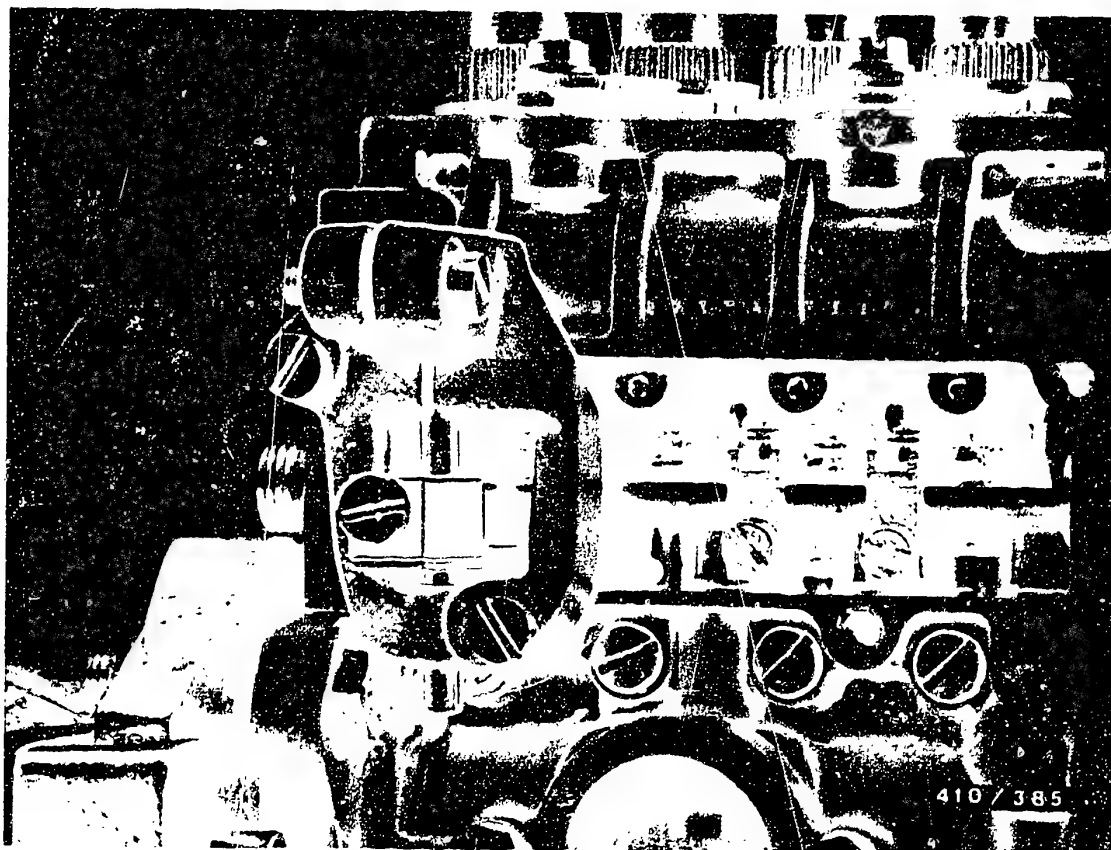
- linkage levers are not unhinged,
- do not rub against the upper valve seats or plunger return springs, and
- are not tilted in the clamping pieces.

Tighten clamping pieces to 3...5 Nm.

Note:

Control rod must rush back from "start to stop" when control rod is turned.





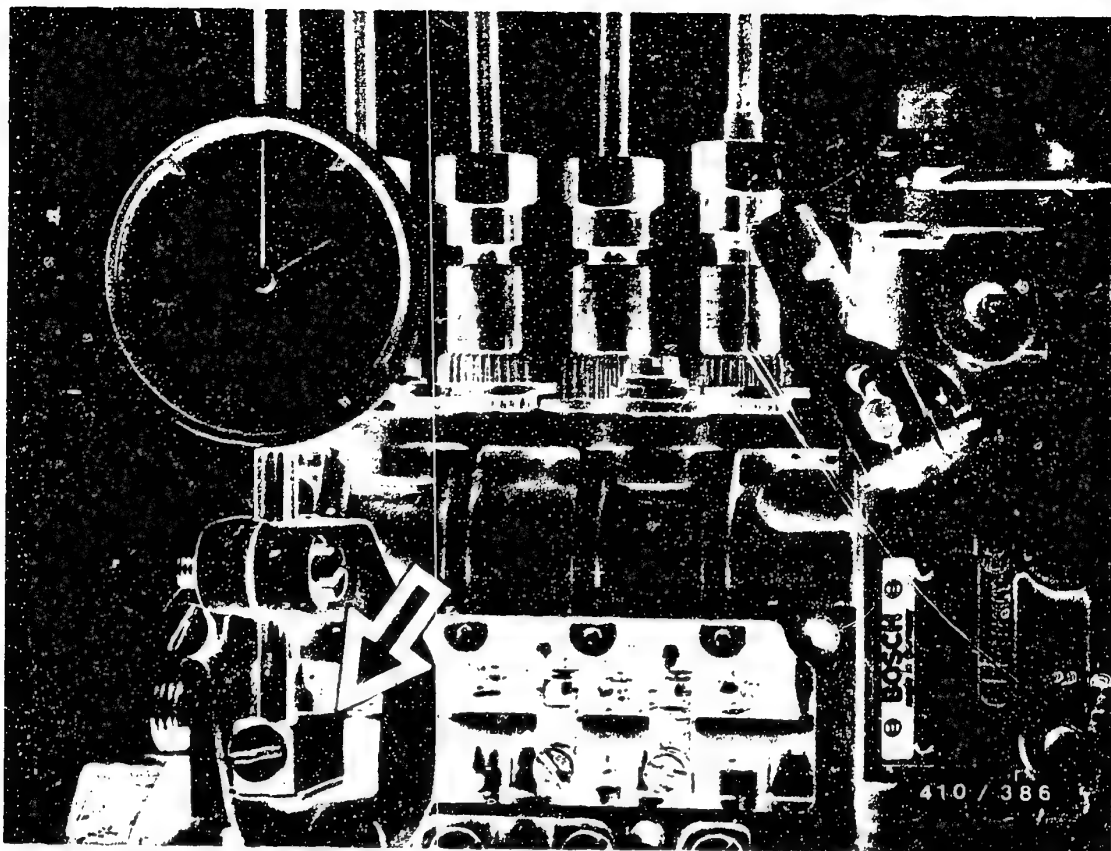
11.13 Testing and adjusting prestroke at start of delivery

Mount injection pump on coupling of test stand. Mount measuring tool 1 681 440 017 for measurement of prestroke at cylinder 1 of the injection pump.

Note:

On pumps with FBG system, use the measuring tool altered per Technical Bulletin VDT-I-400/1003. In doing this, make sure that the feeler of the measuring tool rests on the roller tappet of the first cylinder and is not in contact with the plunger spring.





Arrow = Measuring tool

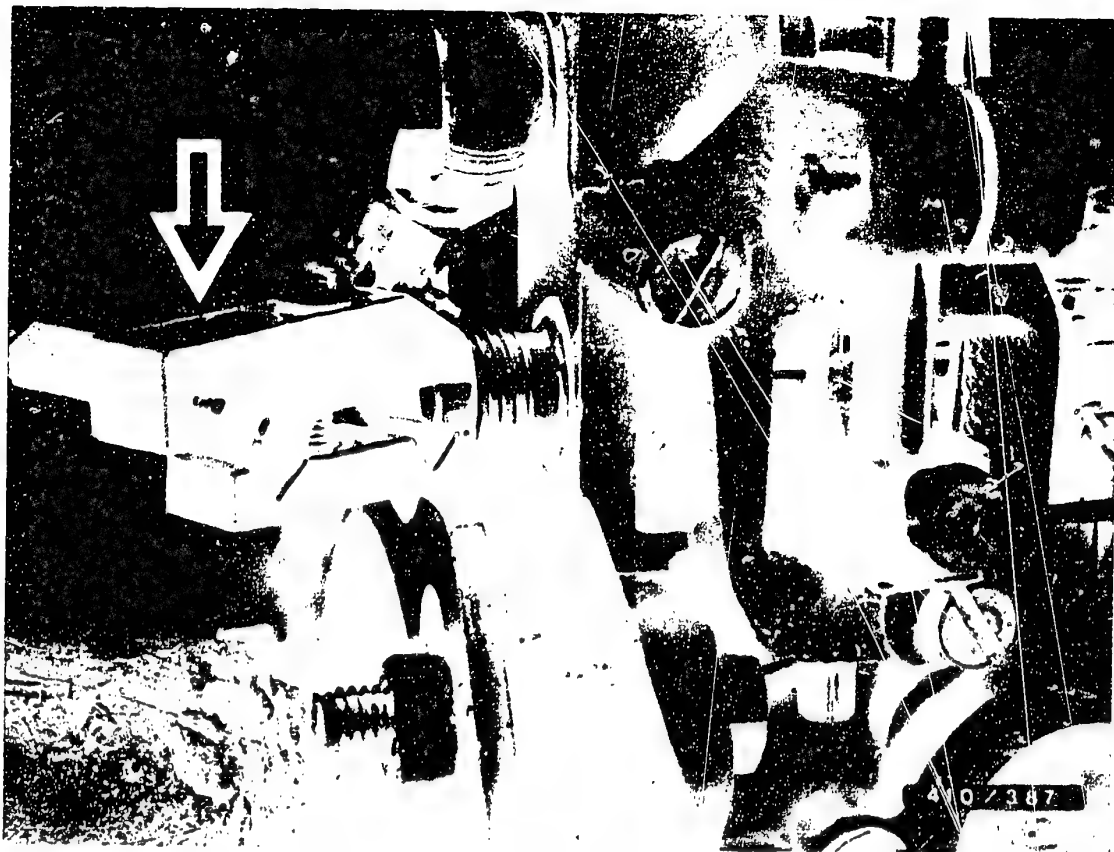
Mount dial indicator 1 687 233 011 in prestroke measuring tool and set to "0" in BDC position of roller tappet.

Attach calibrating-oil supply and test-pressure lines to injection pump.

Note:

When the prestroke measuring tool is mounted, the camshaft of the injection pump must not be rotated through a whole revolution, as this would damage the measuring feeler.





Arrow = Clamping piece

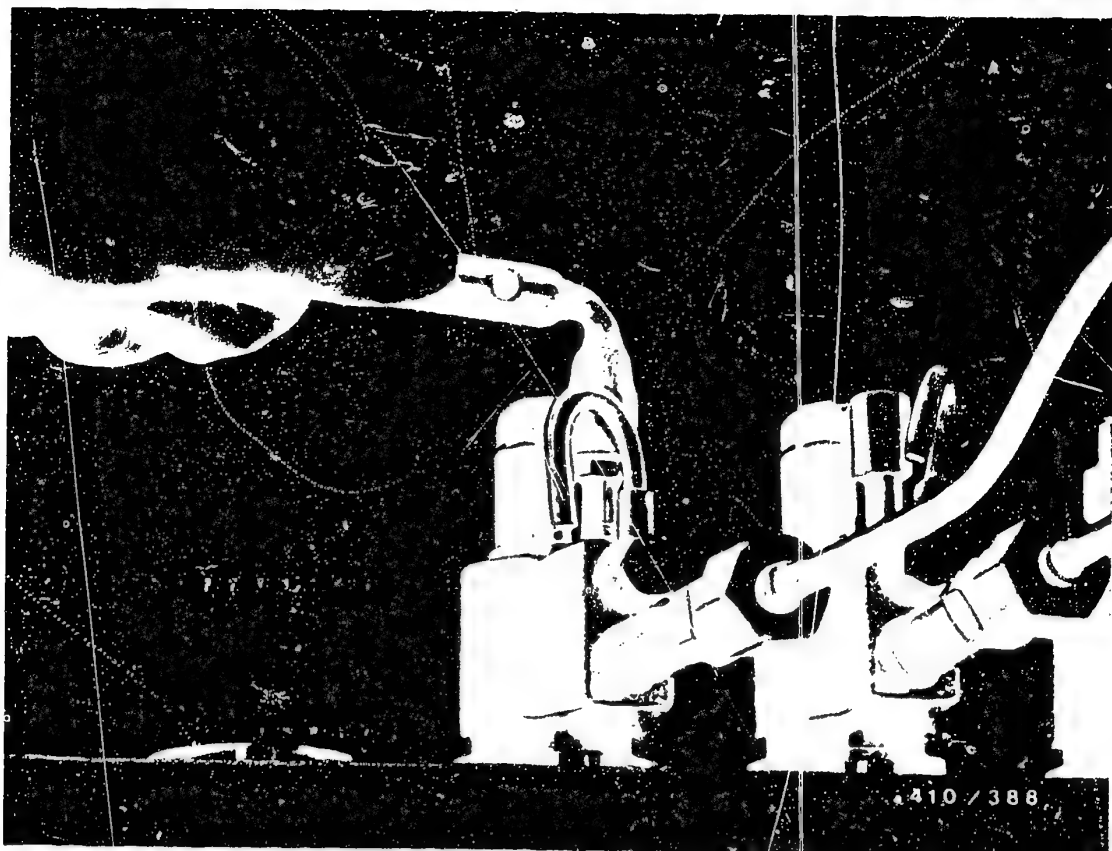
Push control rod up to stop in the direction of starting, and fix in this position with the clamping piece of the control-rod travel measuring tool (illustration).

E23

Assembling injection pump

PES..M., 0 410 ..





Open bleeder screw on overflow pipe of calibrating nozzle-holder assembly at first cylinder.

Switch on test bench and increase supply pressure until fuel exits at the overflow pipe free of bubbles.

Turn injection-pump camshaft in direction of pump rotation until start of delivery is reached.

E24

Assembling injection pump

PES..M..., 0 410 ..



Start of delivery is reached when the flow of calibrating oil at the overflow pipe of the calibrating nozzle-holder assembly becomes a series of drips.

Prestroke is the travel from the BDC position of the plunger to start of delivery.

When start of delivery is reached read plunger stroke at dial indicator and compare with nominal value per test-specification sheet.

If nominal and actual values agree, move indicator on flywheel of test bench to a "whole" increment and note this value.

If actual and nominal values do not agree, proceed as follows:

Turn injection-pump camshaft back to BDC position of first cylinder.

Then turn camshaft back in direction of pump rotation until stroke per test-specification sheet (nominal value) is reached.

In this position, move indicator on flywheel of test bench to a "whole" increment and note this value.

Continue turning camshaft until the flow of calibrating oil breaks down into a series of drips, and read increment number on indicator of flywheel.

Calculate and note the difference from the increment at nominal value.



Remove prestroke measuring tool with dial indicator from injection pump.

Close bleeder screw at calibrating nozzle-holder assembly of first outlet.

Open bleeder screw at nozzle-holder assembly of next outlet in cam sequence.

Turn camshaft further in direction of pump rotation until start of delivery is reached.

In this position, note increment at indicator of test-bench flywheel.

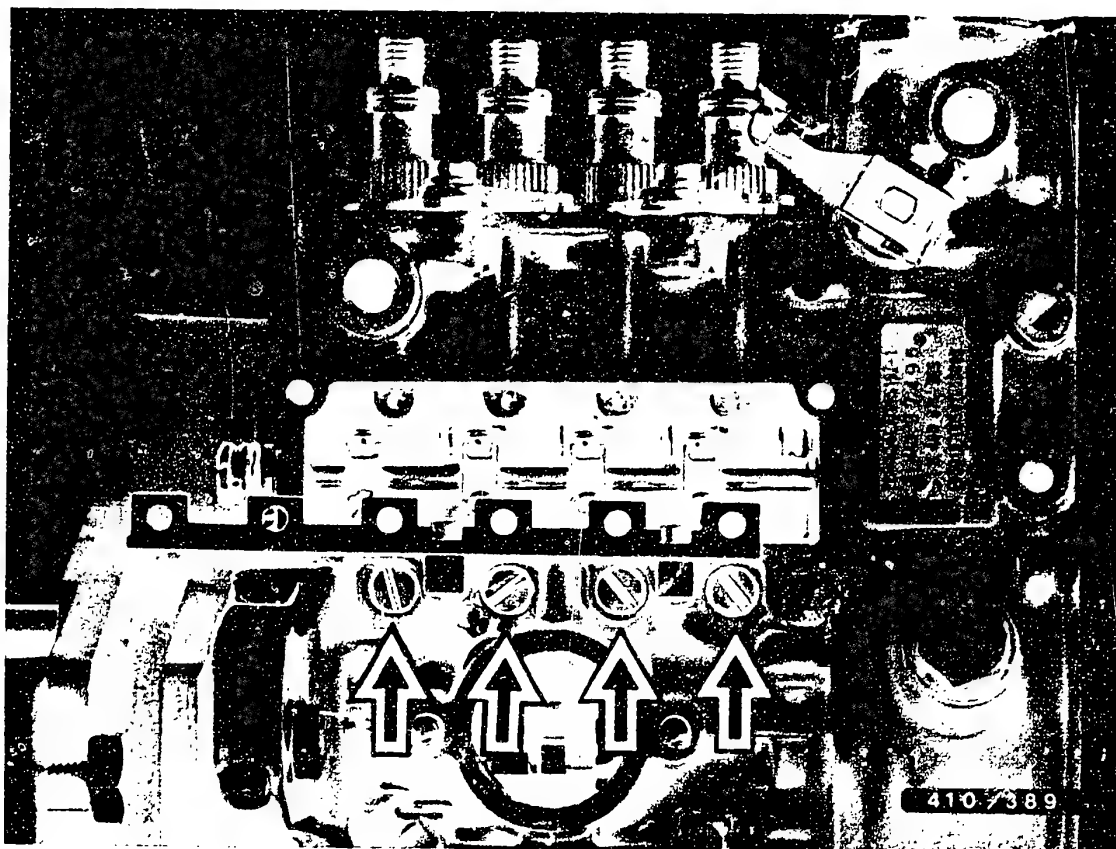
The difference between the increment set at the first cylinder (at nominal value) and that of the following cylinder must be as follows: on 4-cyl. pump, $90 \pm 0.5^\circ$; on 5-cyl. pumps, $72 \pm 0.5^\circ$; on 6-cyl. pumps, $60 \pm 0.5^\circ$.

Note any deviation. Proceed in the same manner with the remaining outlets.

If one or more cylinders show deviations from the nominal value which are outside of tolerances, remove the injection pump from the test bench.

Correct prestroke as follows.





Adjusting prestroke

Affix injection pump to clamping support KDEP 2919. Insert tappet-holding device KDEP 1563 in tapped hole, as appropriate for pumped version, of the spring-chamber cover.

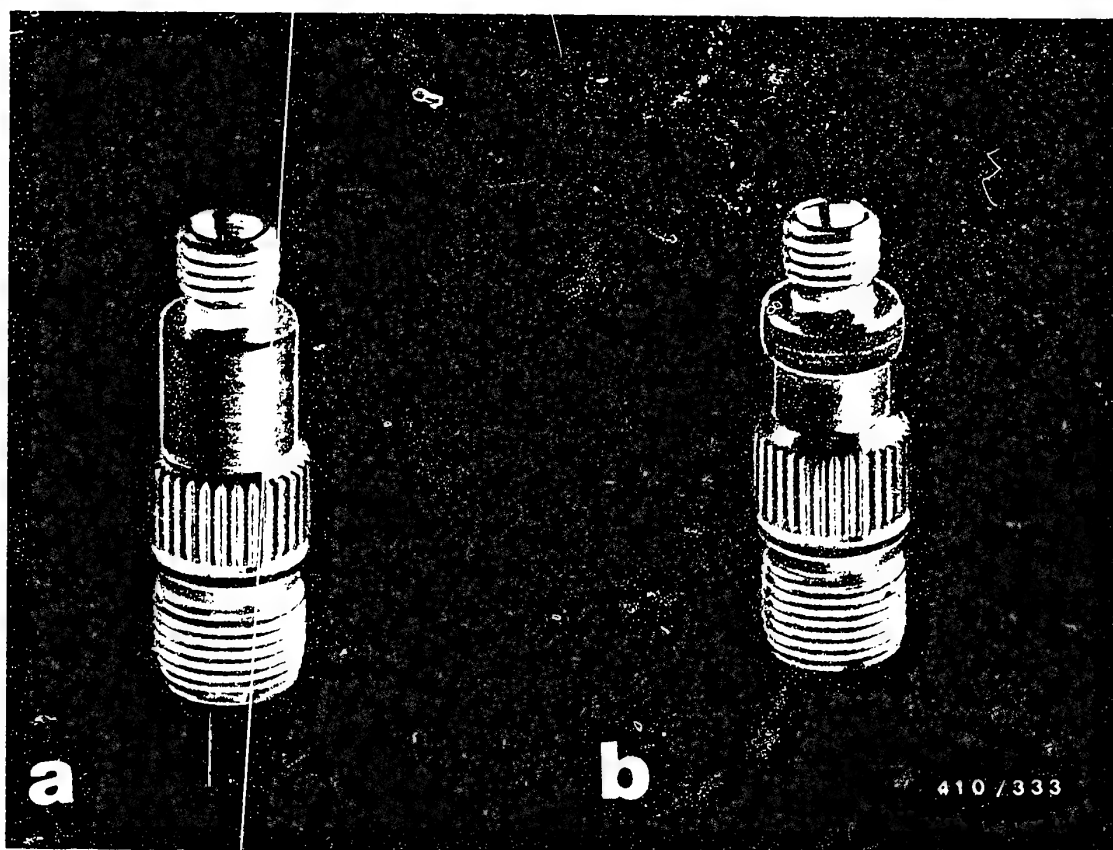
Loosen, but do not completely unscrew, roller-tappet locating screws (arrows).

F3

Assembling injection pump

PES..M.., 0 410 ..



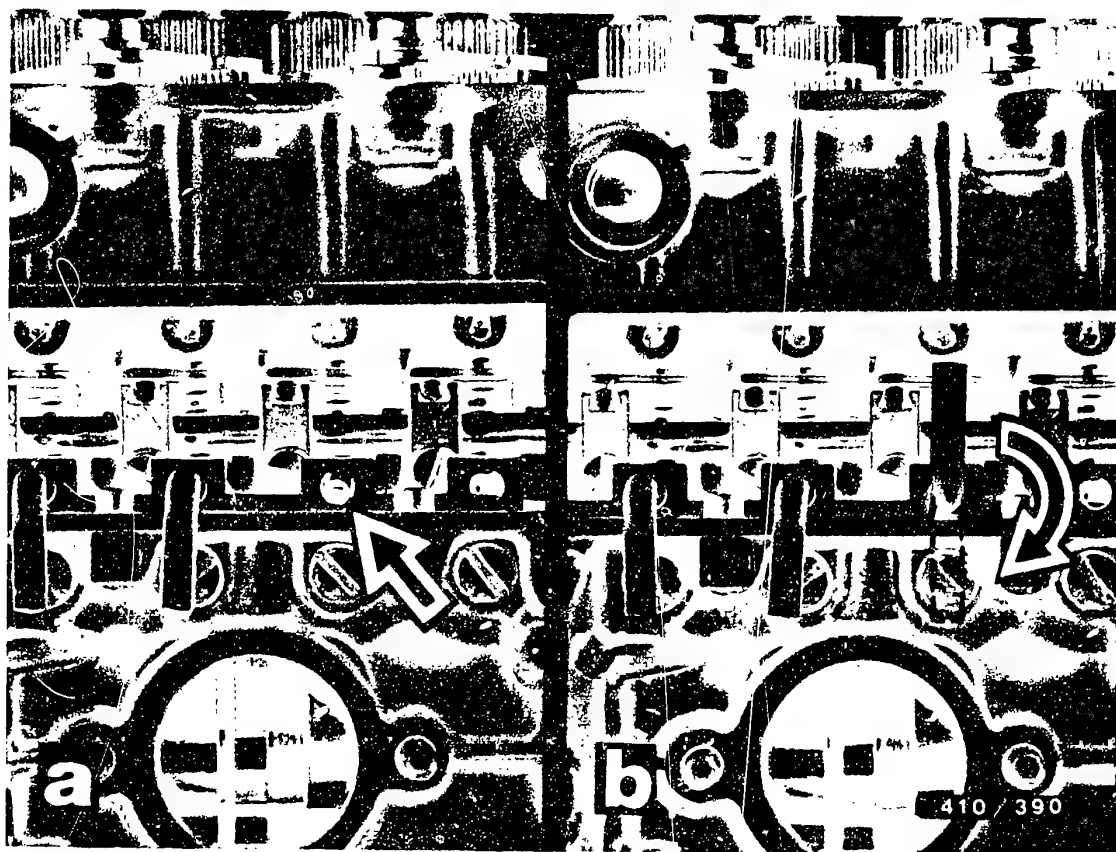


- Inserting tappet holders

On pumps not having collars on the delivery-valve holders, use the tappet holders having larger outside diameter (fig. a).

On pumps with collar or hex nut, use the tappet holders having smaller outside diameter (fig. b).





Slowly turn camshaft until the plunger of the first cylinder is in TDC position (fig. a, arrow). Insert tappet holders in holes so that the eccentric projection points downwards in the direction of the camshaft. Turn tappet holder 180°. This causes the eccentric projection to lift the roller tappet from the cam of the camshaft. Turn camshaft further and carry out the same procedure with the other roller tappets.

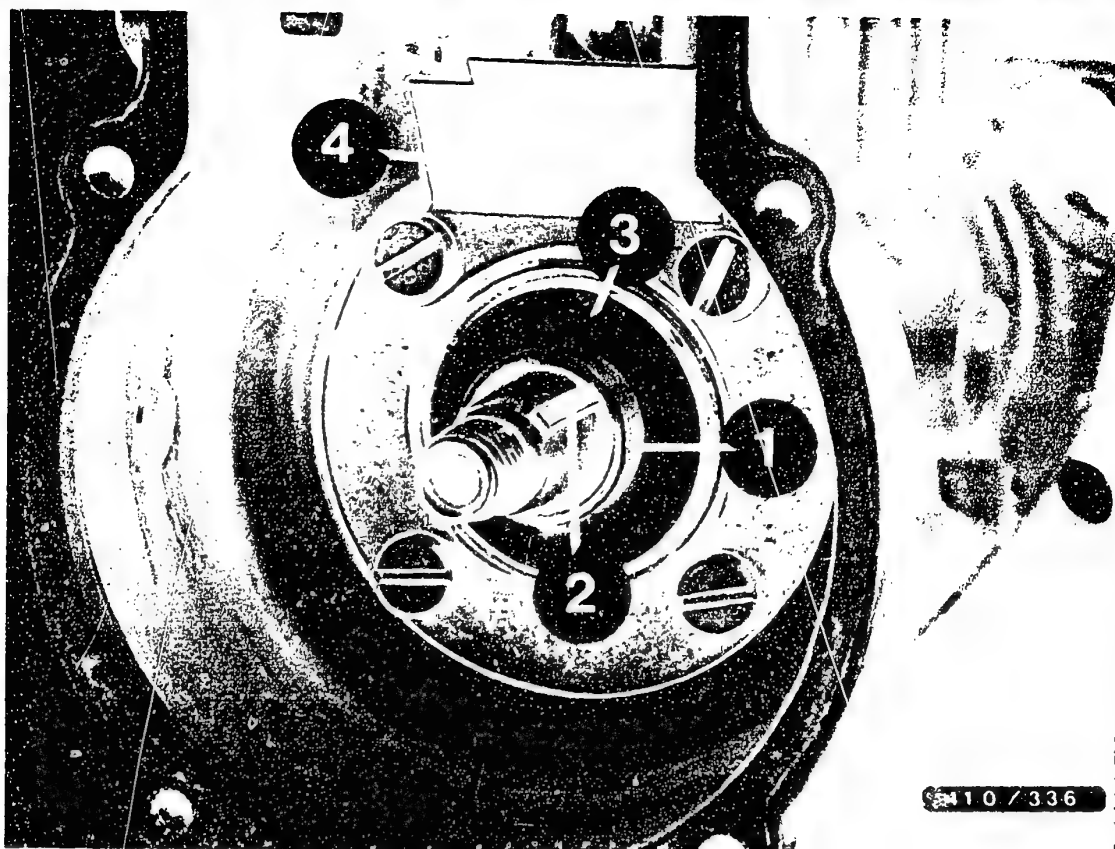
Remove drive coupling from camshaft.

F5

Assembling injection pump

PES..M.., 0 410 ..





1 = Spacer sleeve
3 = Disk spring

2 = Woodruff key
4 = Supporting plate

11.13.1 Preparations for camshaft removal

Remove spacer sleeve, Woodruff key, disk spring, and holding plate behind disk spring.
Remove supporting plate.

Note:

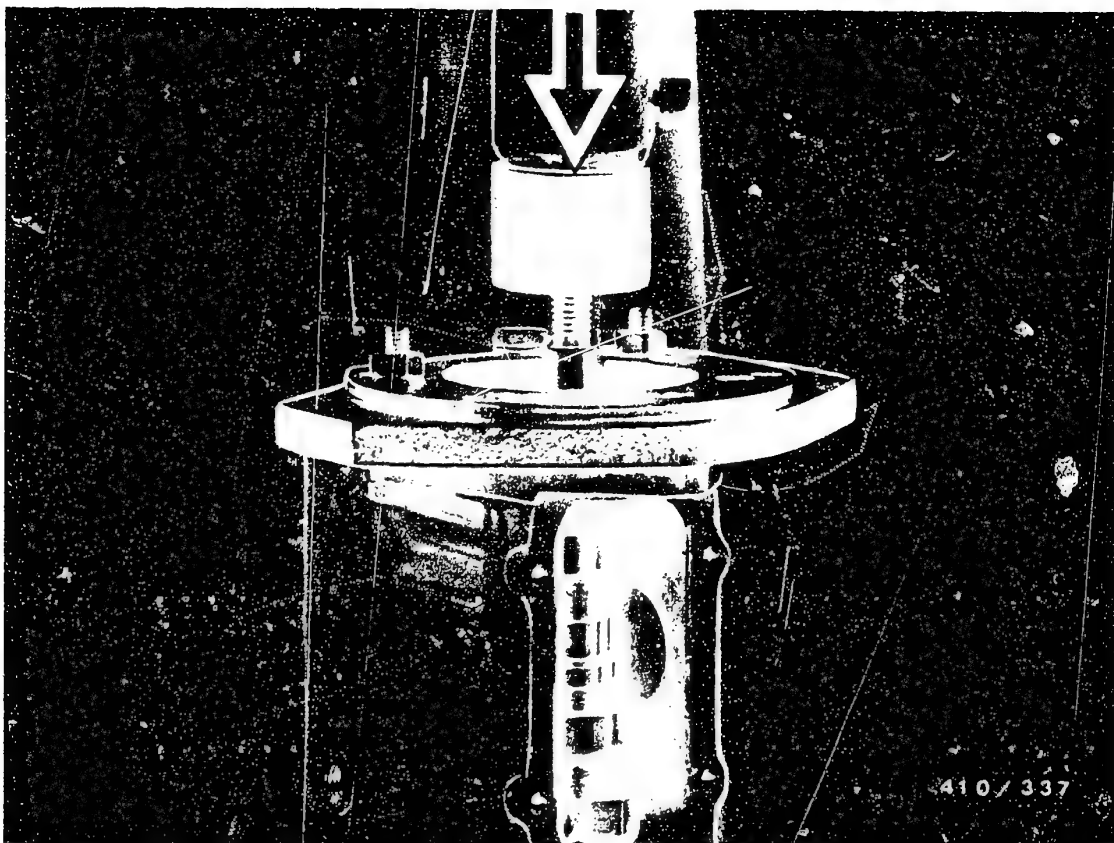
Pumps with FBG have no Woodruff key.

F6

Assembling injection pump

PES..M., 0 410 ..



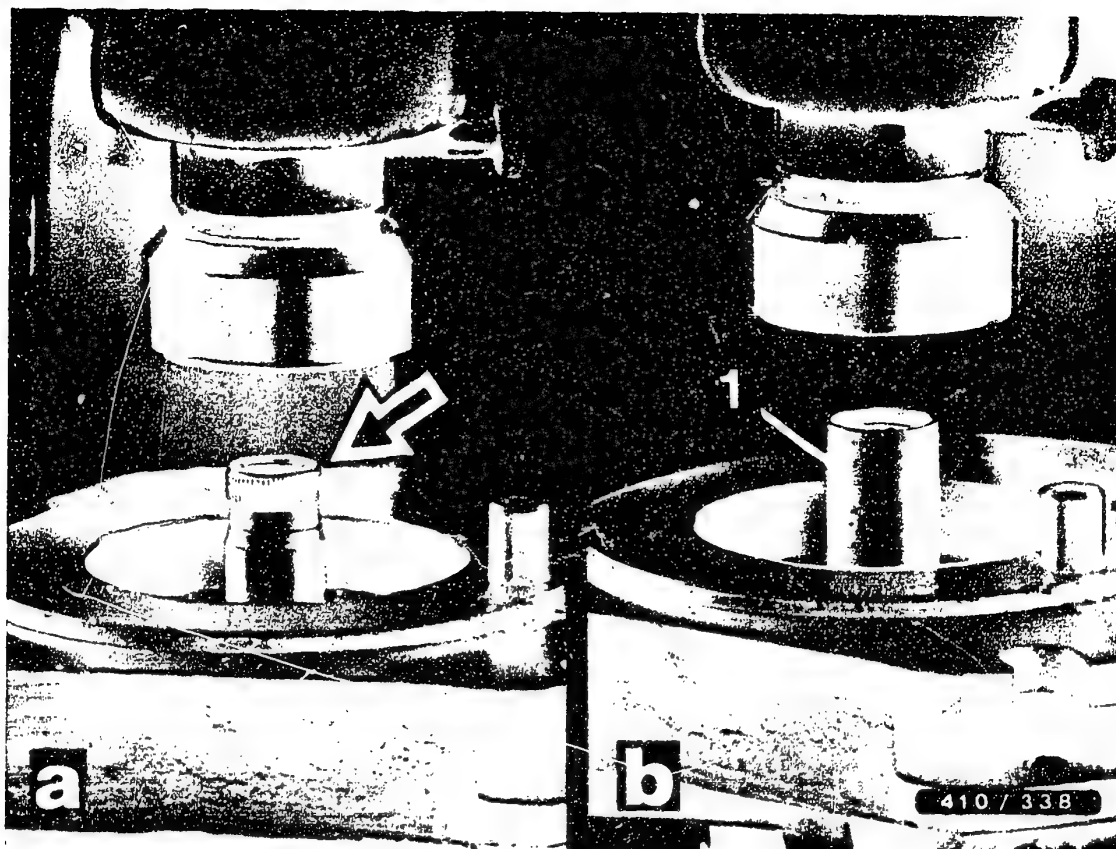


11.13.2 Removing camshaft

Dismount injection pump from clamping support and press camshaft out in the direction of the governor with an arbor press.

Remove injection pump from arbor press and remount in clamping support KDEP 2919.





1 = Press-out sleeve

11.13.3 Removing camshaft (pumps with FBG)

Take injection pump out of clamping support.

To protect the serration on the camshaft (arrow), superimpose press-out sleeve KDEP 1588.

Press the camshaft out in the direction of the governor with an arbor press.

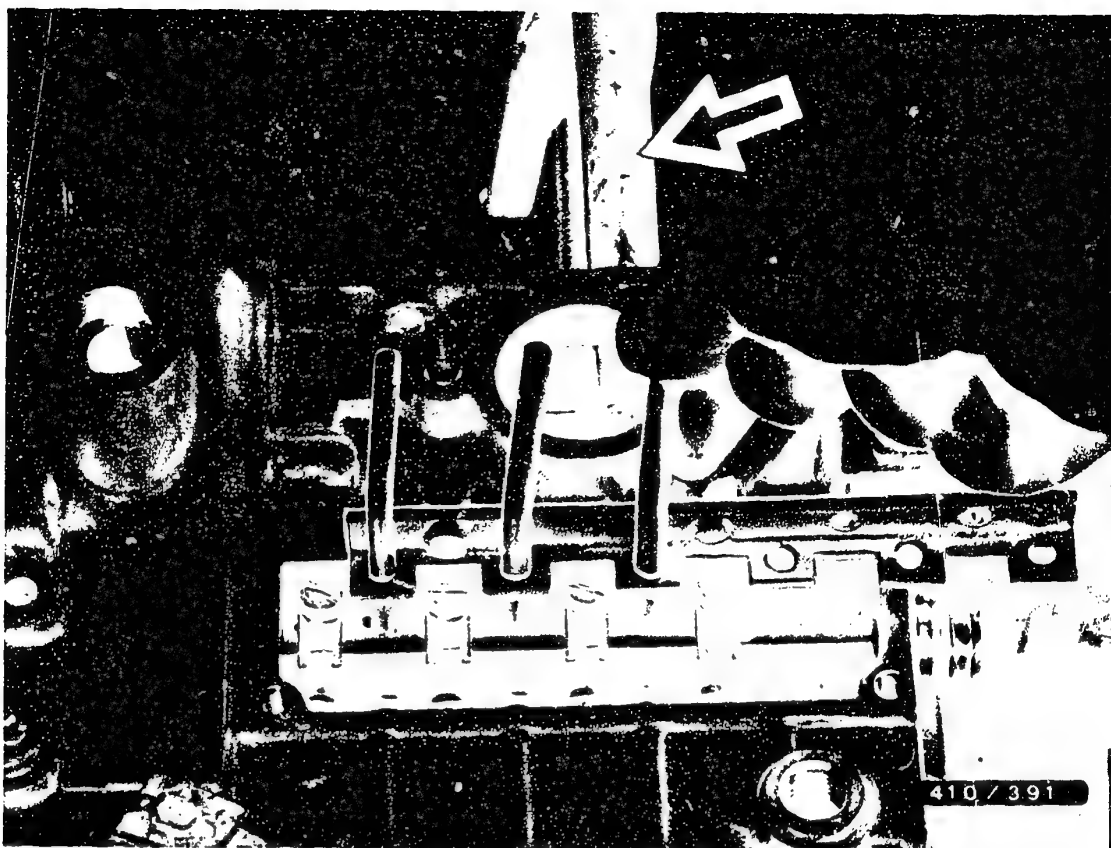
Take injection pump out of arbor press and remount in clamping support KDEP 2919.

F8

Assembling injection pump

PES..M.., 0 410 ..





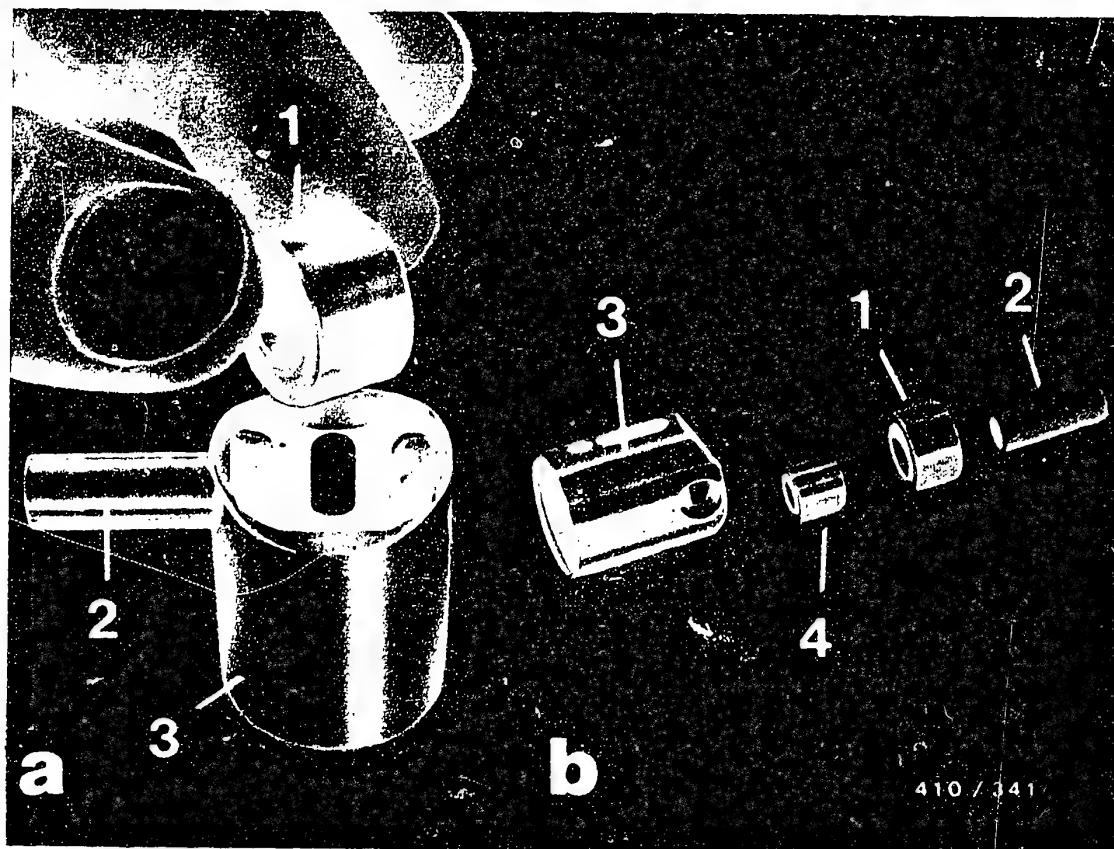
Arrow = Tappet mounting device

11.13.4 Removing roller tappets

Mount KDEP 1505 mounting device.
Position mounting-device tappet on the roller of the
roller tappet whose prestroke deviates from the
nominal value.

Press down roller tappet and remove the appropriate
tappet holder.





1 = Roller
2 = Bearing pin

3 = Roller-tappet shell
4 = Bearing bushing

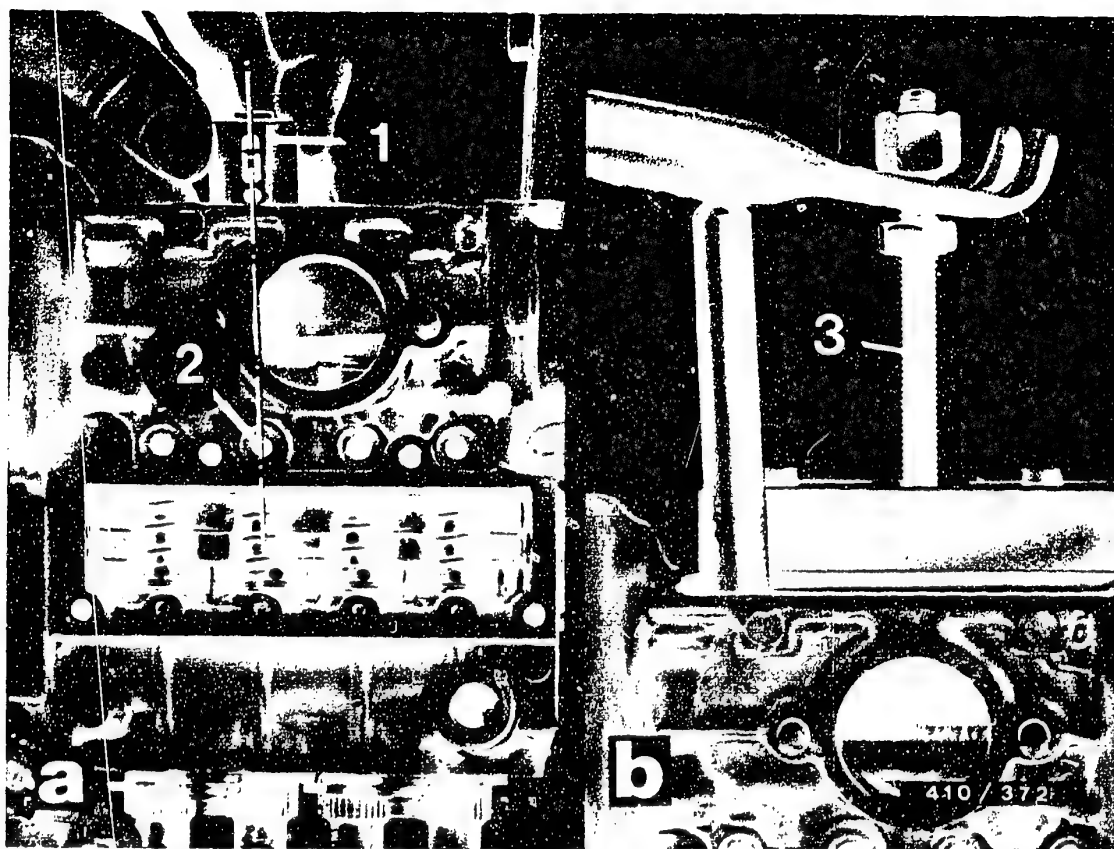
Take roller tappet out of pump housing and remove roller.

Select new roller per service-parts list in accordance with the recorded increment deviation from the nominal value.

Note:

0.3mm roller diameter corresponds to 1° offset.
Install new roller in tappet.

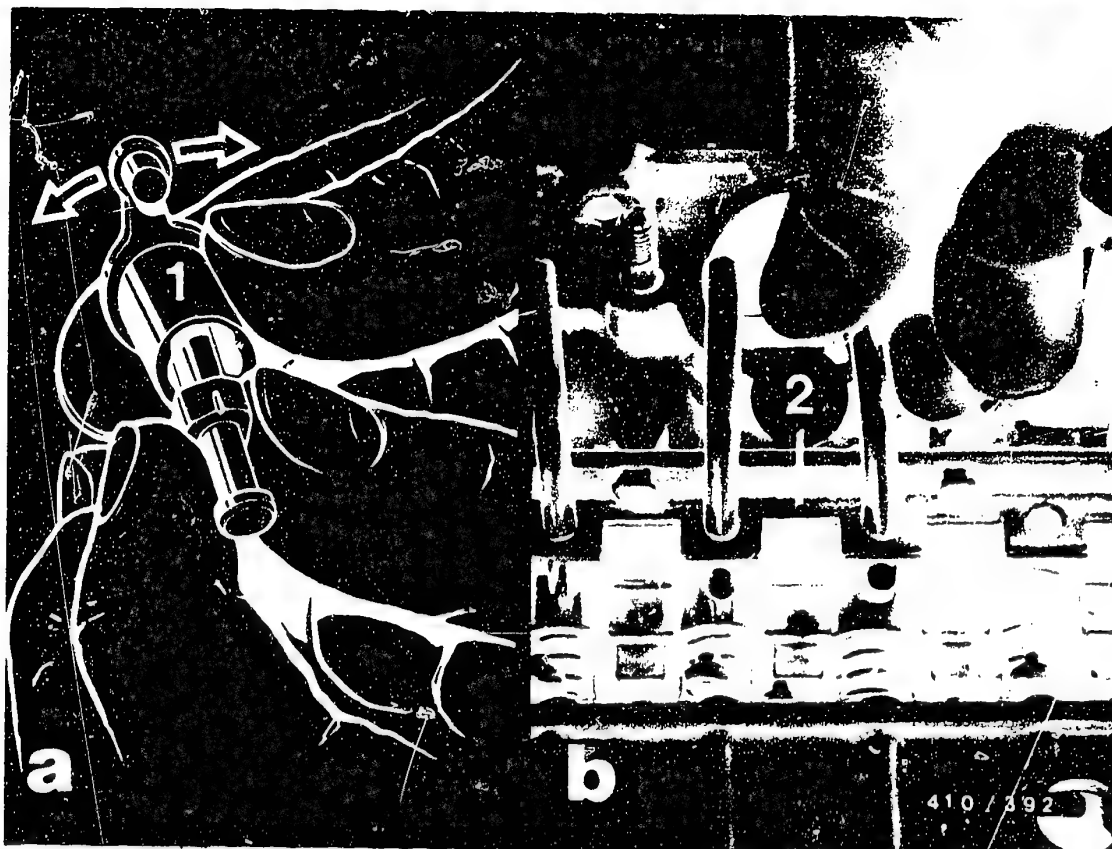




- 1 = Roller-tappet guide groove
- 2 = Fixing hole
- 3 = Mounting device

11.13.5 Inserting roller tappet

Guide roller tappet into pump housing so that the roller-tappet guide groove faces the locating hole of the guide screw.



1 = Linkage lever

2 = Tappet-holding device

Insert tappet-holding device.

Use pressure piece to push roller tappet down, vibrating slightly.

While doing this, move linkage lever back and forth slightly until plunger control arm catches in linkage lever.

In this position press roller tappet into TDC position.

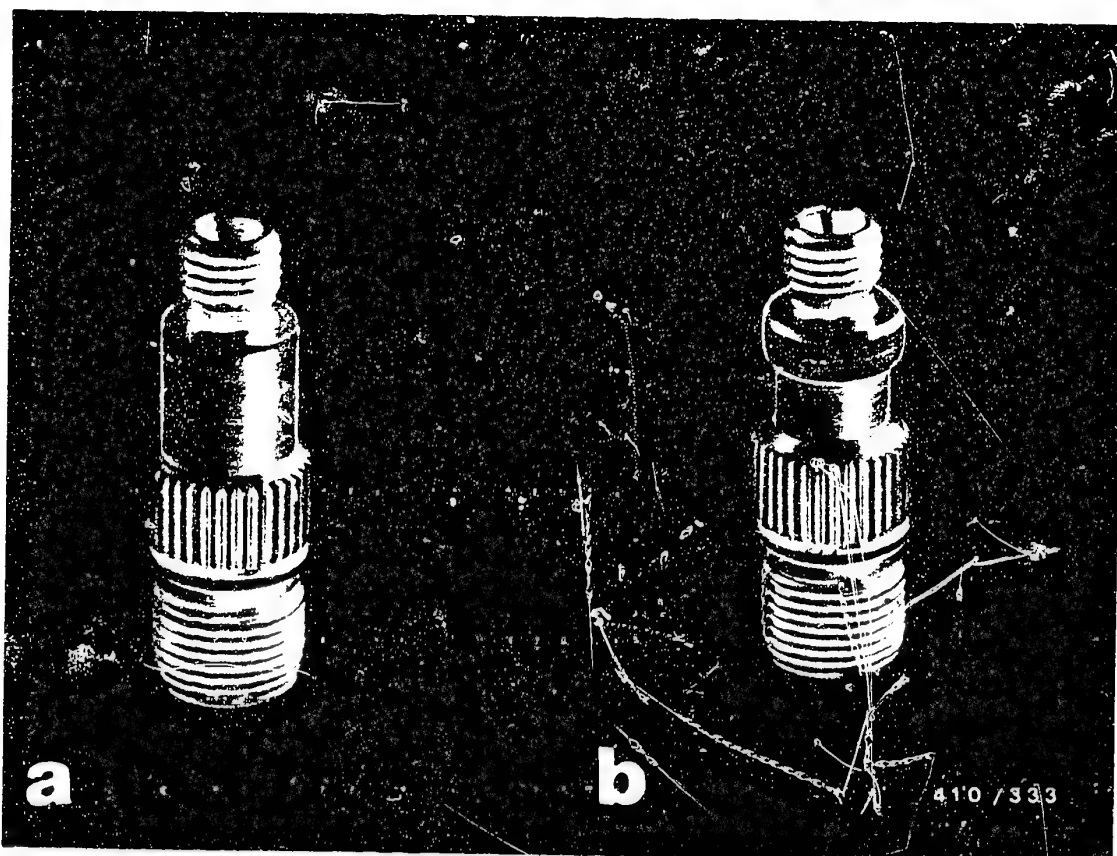
Insert tappet holder appropriate for pump version into holding device and fix roller tappet in TDC position.

F12

Assembling injection pump

PES..M.., 0 410 ..



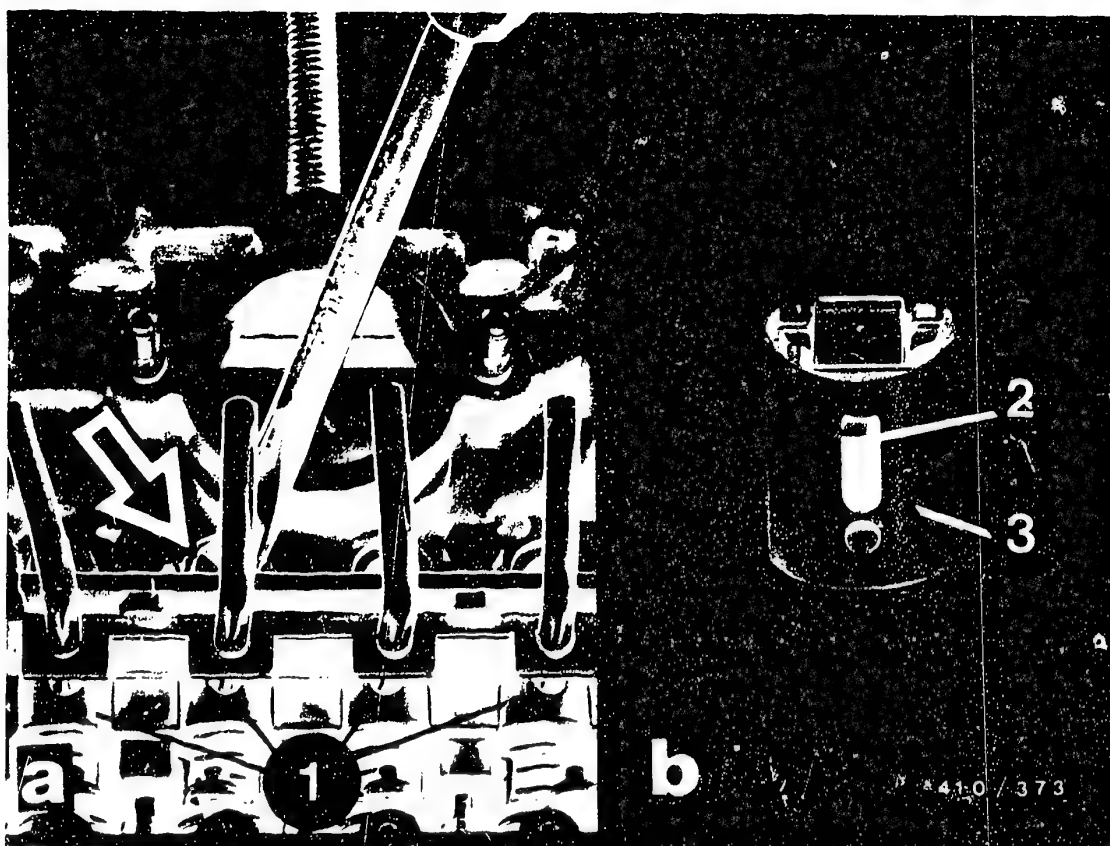


- Inserting tappet holders

On pumps not having collars on the delivery-valve holders, use the tappet holders with larger outside diameter (fig. a).

On pumps with collar or hexagonal nut, use the tappet holders with smaller outside diameter (fig. b).





1 = Control sleeves
2 = Guide groove

3 = Roller-tappet shell

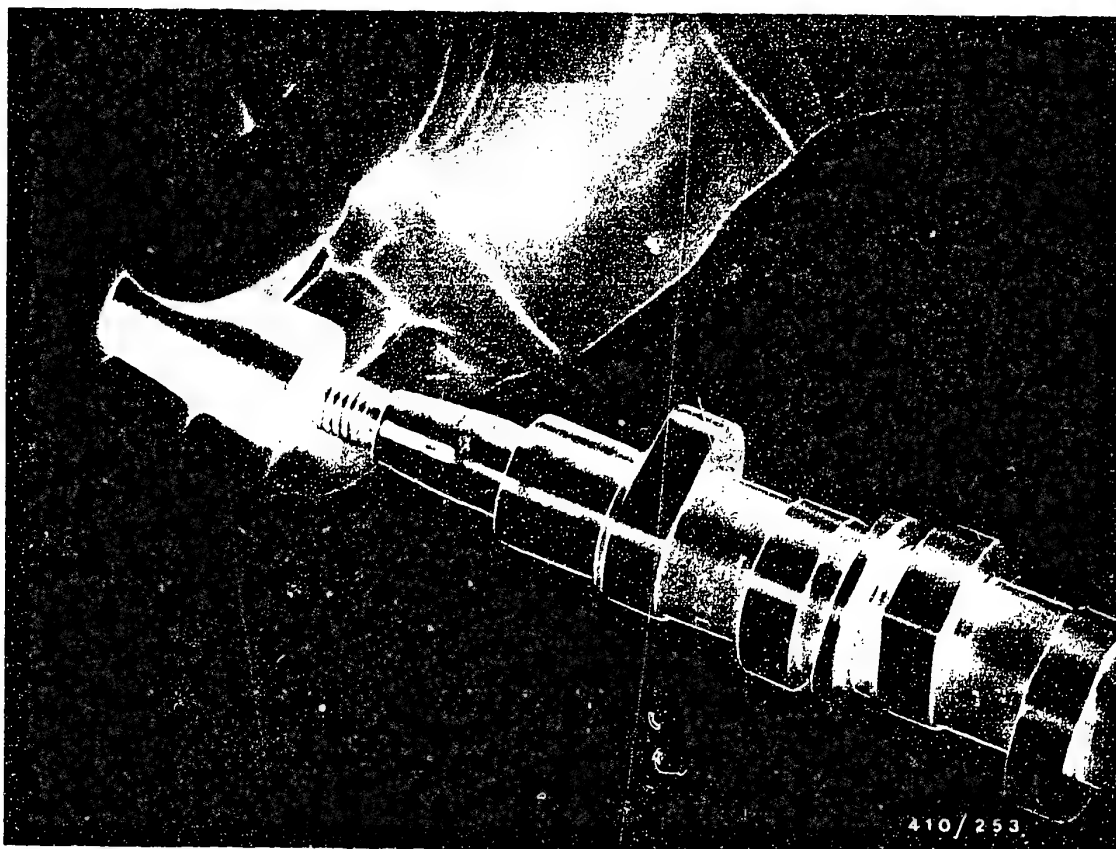
Screw in roller-tappet guide screws (arrow) (use micro-encapsulated screws per service-parts list).

Note:

When screwing in the roller-tappet locating screws, make sure that the locating screw enters the guide groove and does not press on the roller-tappet shell (danger of breakage).

Test control sleeves for freedom of movement and discernible vertical play.





11.13.6 Installing camshaft

Mount bearing end plate.
Remove injection pump from clamping support KDEP 2919.

Screw assembly sleeve KDEP 2874 onto drive-side cone
in order to protect radial-lip-type oil seal.





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Before installing camshaft, take note of groove marking which is found only on one end face of the two threaded ends (see illustration, arrow).

The installation position of the marking provides for the correct cam sequence, and is determined by the assembly number of the injection pump.

Note:

With cones having differing diameters, the larger diameter always faces the drive side.

F16

Assembling injection pump

PES..M.., 0 410 ..



Explanation of assembly numbers

Supply pump (mounting side and number)																		
Mounted on:														Pump sides				
without		1 each		2 each		1 each		2 each		1 each		2 each		Governor	Timing device	Plunger control edge		
Shaft position (designated by grooves on shaft end)														on pump side	on pump side			
1	2	1	2	1	2	1	2	1	2	1	2	1	2	(1)		on bottom	on top	
100	200	300	400	500	600	700	800	900	1000					-	-			
101	201	301	401	501	601	701	801	901	1001					-	1			
102	202	302	402	502	602									-	2	left-handed	right-handed	
110	210	310	410	510	610									1	-			
112	212	312	412	512	612									1	2			
120	220	320	420	520	620	720	820	920	1020	1320	1520			2	-			
121	221	321	421	521	621	721	821	921	1021					2	1	right-handed	left-handed	

Example: 421

Injection pump with shaft position 2 and a supply pump on pump side 3, governor on pump side 2 and timing device on pump side 1.

On 2-cylinder injection pumps of size A, the first 3../. = 90° or 270° in shaft position 1;

4../. = 180° in shaft position 2.

A code number representing the possibility of mounting a supply pump can be added to the assembly number, e.g.:

../3 = With mounting opening for supply pump, closed by cover (without supply pump).

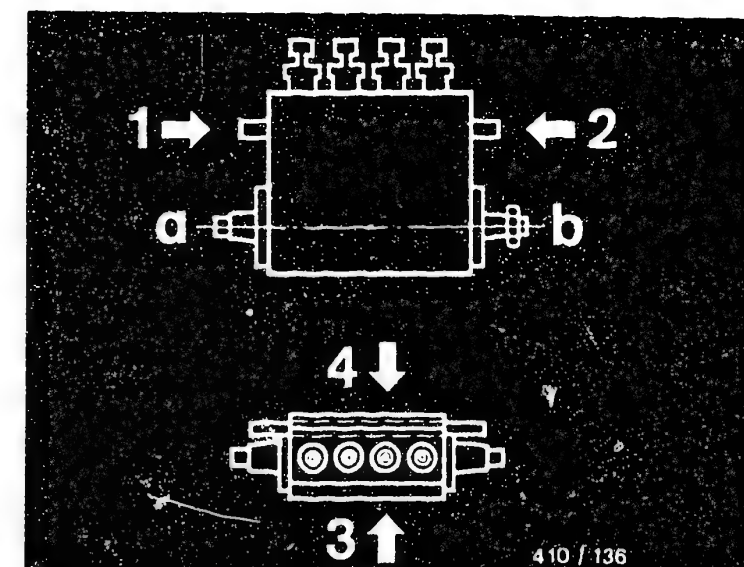
../4 = With 2 mounting openings, on left with supply pump, on right closed with cover.

../5 = With 2 mounting openings, left closed with cover, right having supply pump.

../6 = With 2 mounting openings, both closed with cover (without supply pump).

../7 = With 2 mounting openings each on sides 3 and 4, right opening closed with cover.

1) The entire injection assembly is turned by 180° with assembly numbers beginning with odd characters (300, 500, 700 etc.) with governor position 2.



3.4 = With pump size M, when cover at front and control rod at rear.

a = Shaft position 1 (here with grooves on shaft end)

b = Shaft position 2 (here with grooves on shaft end)

F17

Assembling injection pump

PES..M.., 0 410 ..

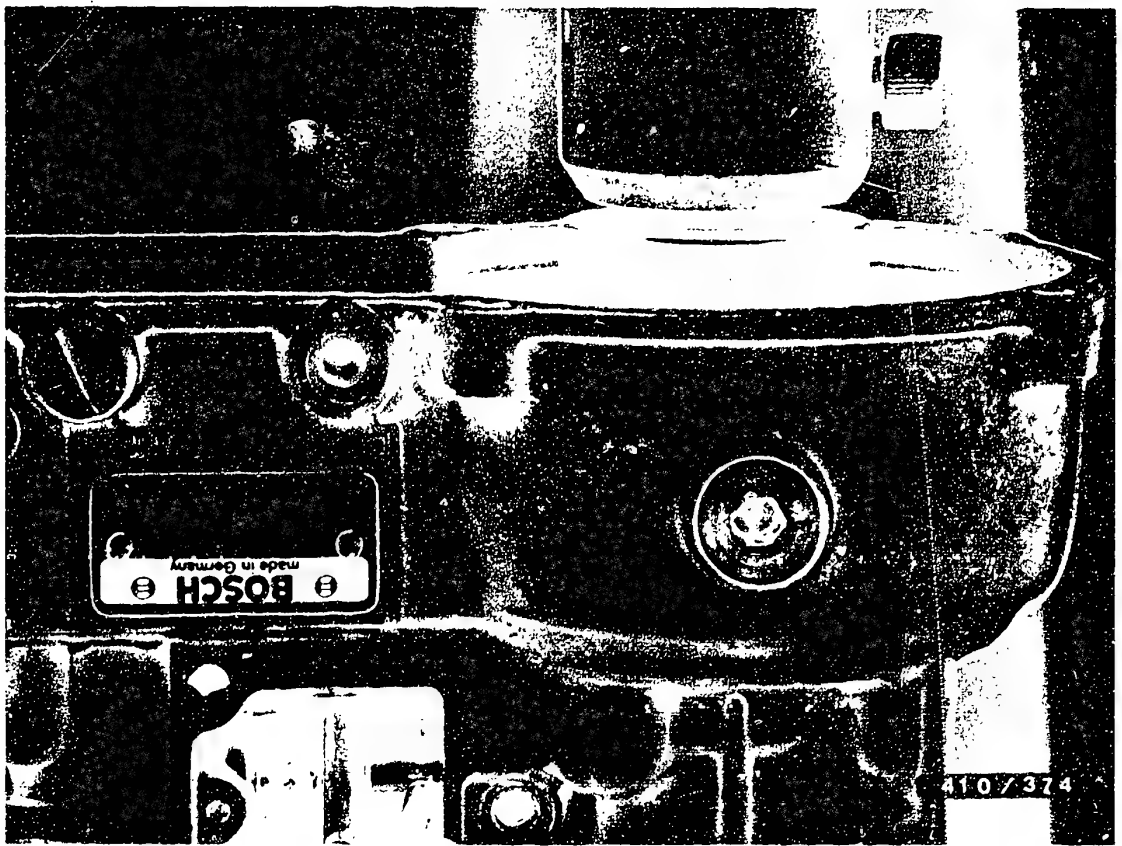


F18

Assembling injection pump

PES..M.., 0 410 ..





Insert camshaft.

Screw guide sleeve (found in parts set of press-in tool KDEP 1049) onto camshaft on governor side.

Push press-in sleeve over guide sleeve and press deep-groove ball bearing into pump housing down to stop under arbor press.

Note:

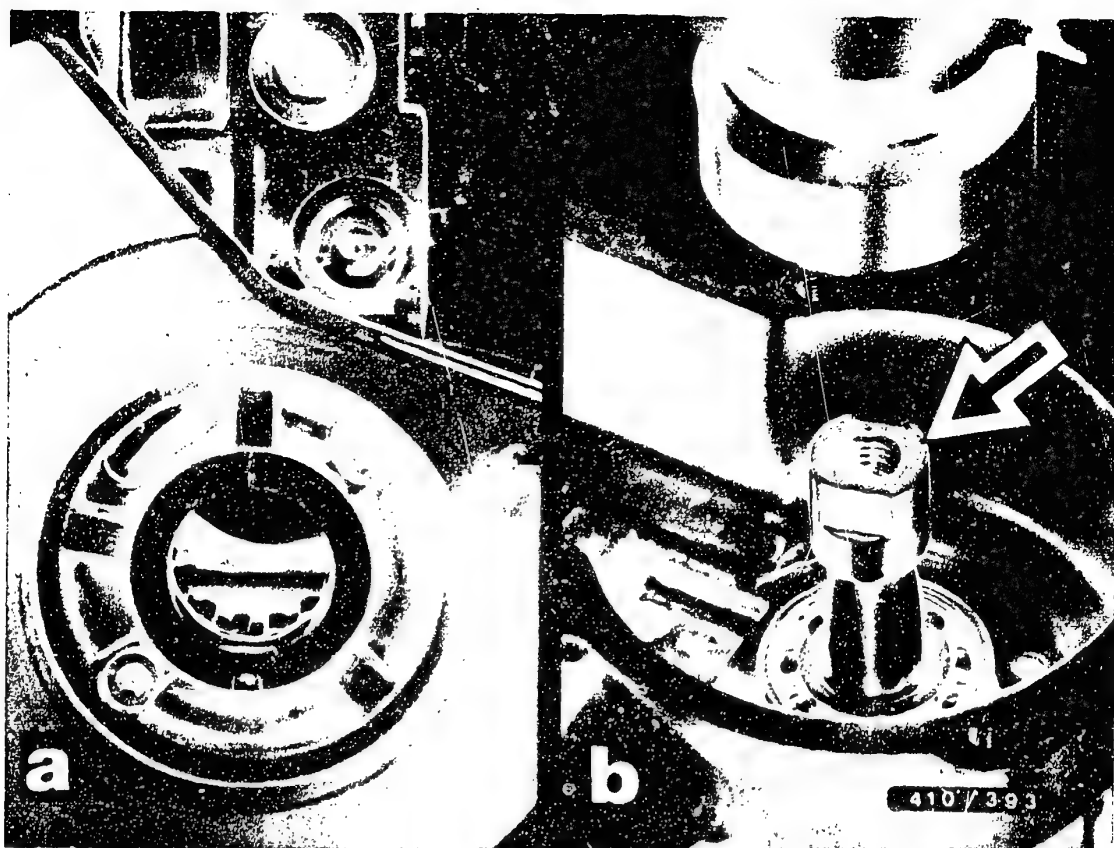
Apply pressure only to the outer race of the deep-groove bearing.

F19

Assembling injection pump

P2S..M.., 0 410 ..



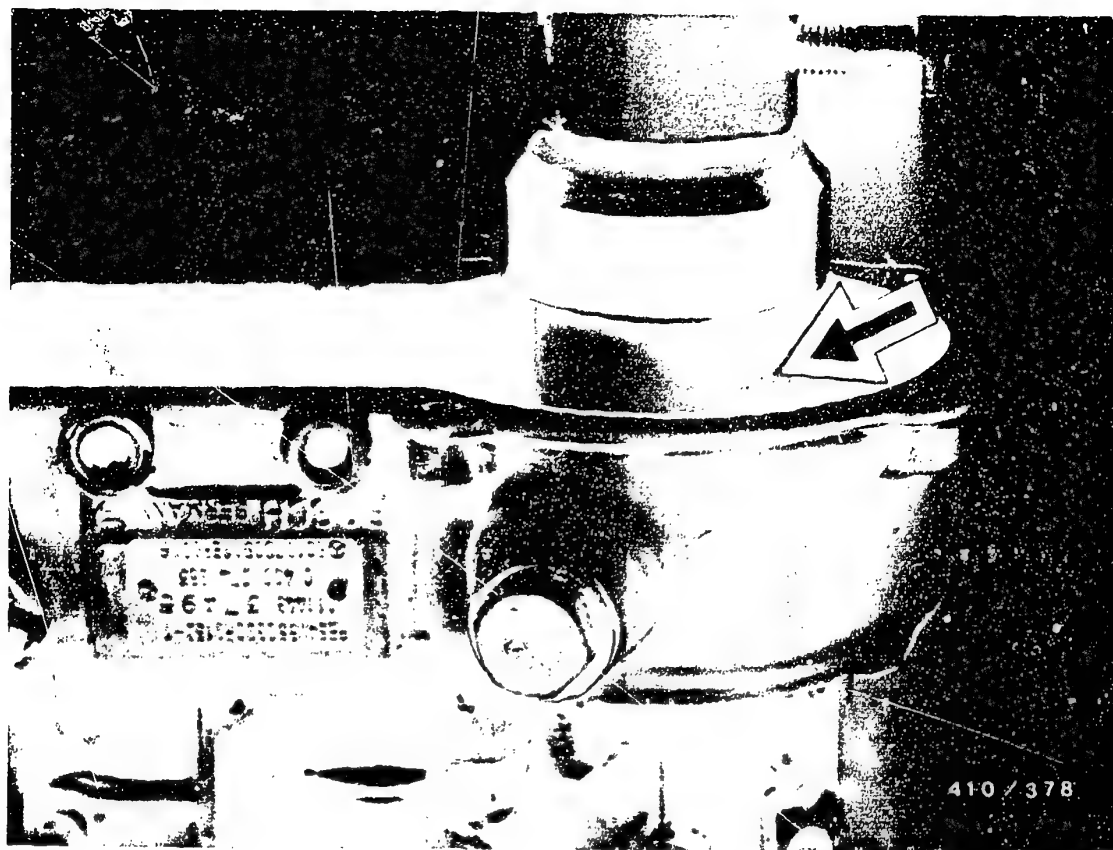


11.13.7 Installing camshaft (Pumps with FBG)

Remove injection pump from clamping support KDEP 2919. Insert camshaft.

Screw guide sleeve (fig. b, arrow, found in parts set of press-in tool of KDEP 1049) onto camshaft on governor side.



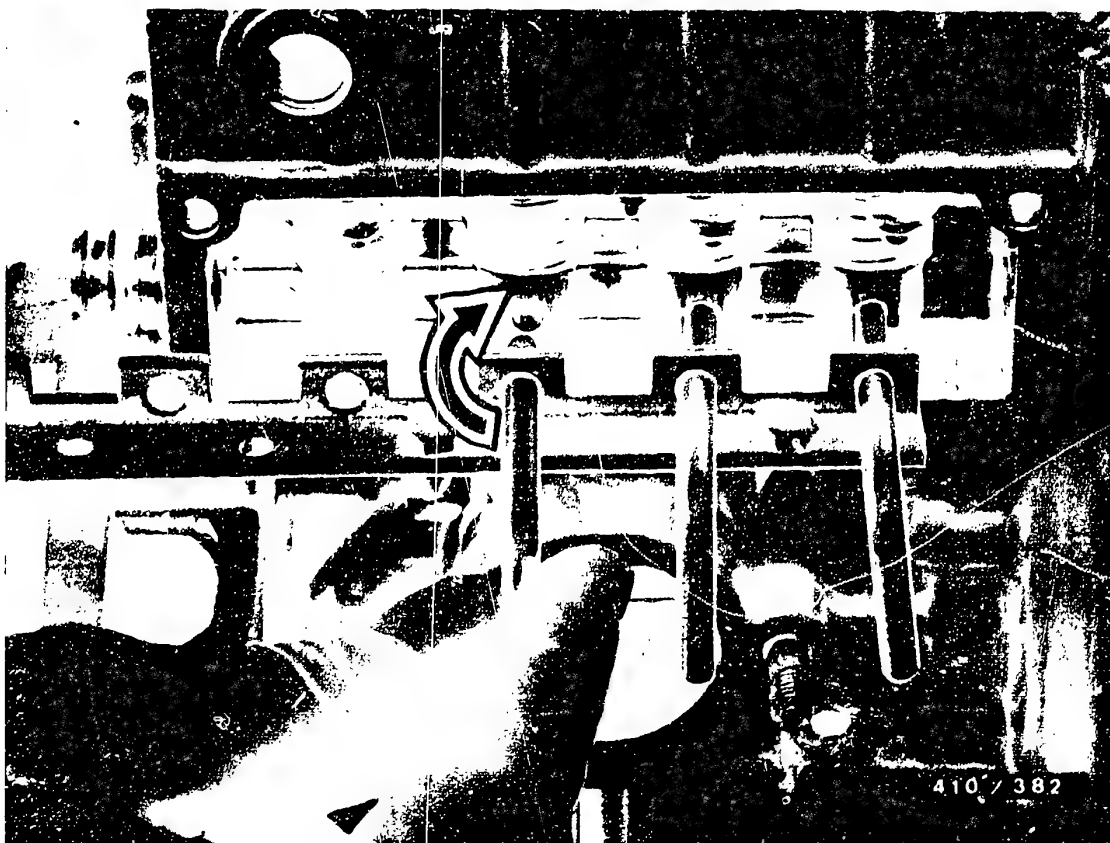


Push press-in sleeve (arrow) over guide sleeve and press deep-groove ball bearing into pump housing down to stop under arbor press.

Note:

Apply pressure only to the outer race of the deep-groove bearing.





11.13.8 Dismounting tappet holders

Affix injection pump in clamping support KDEP 2919.

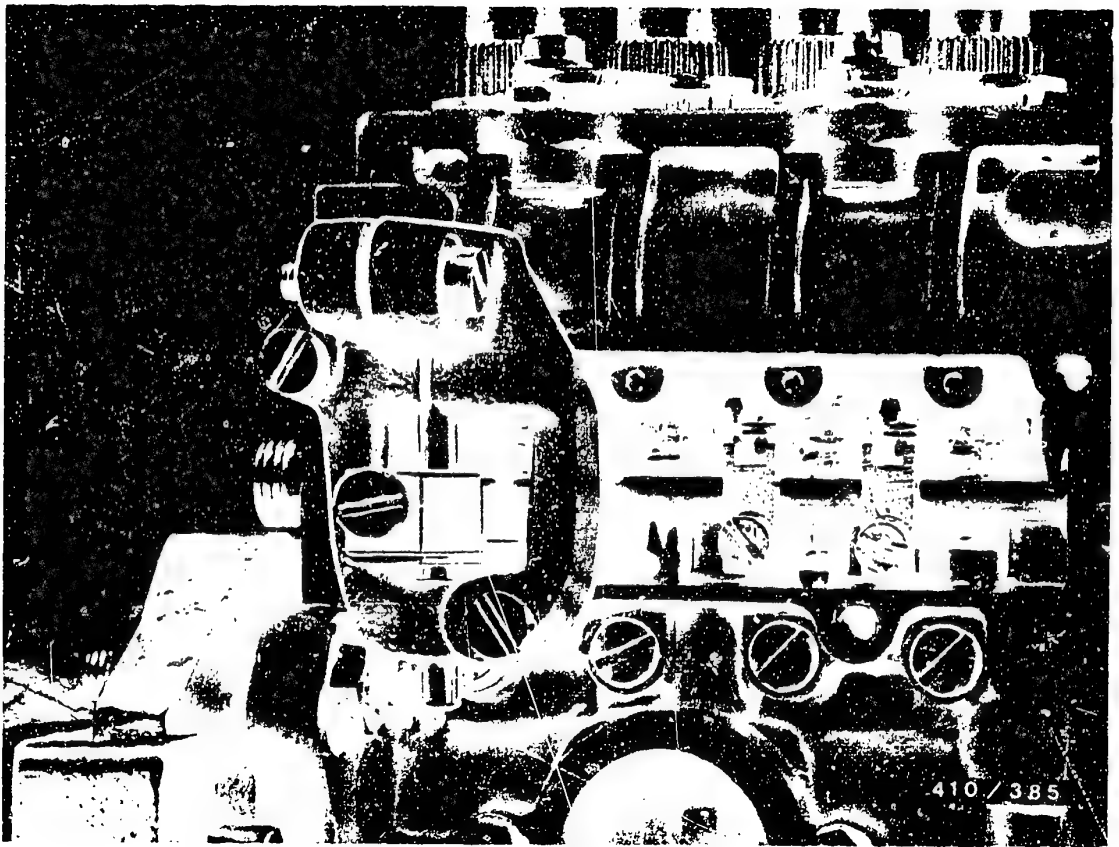
Mount drive coupling.

Turn tappet holder 180°.

Turn camshaft until cam lobe lifts roller tappet.

Remove tappet holder.





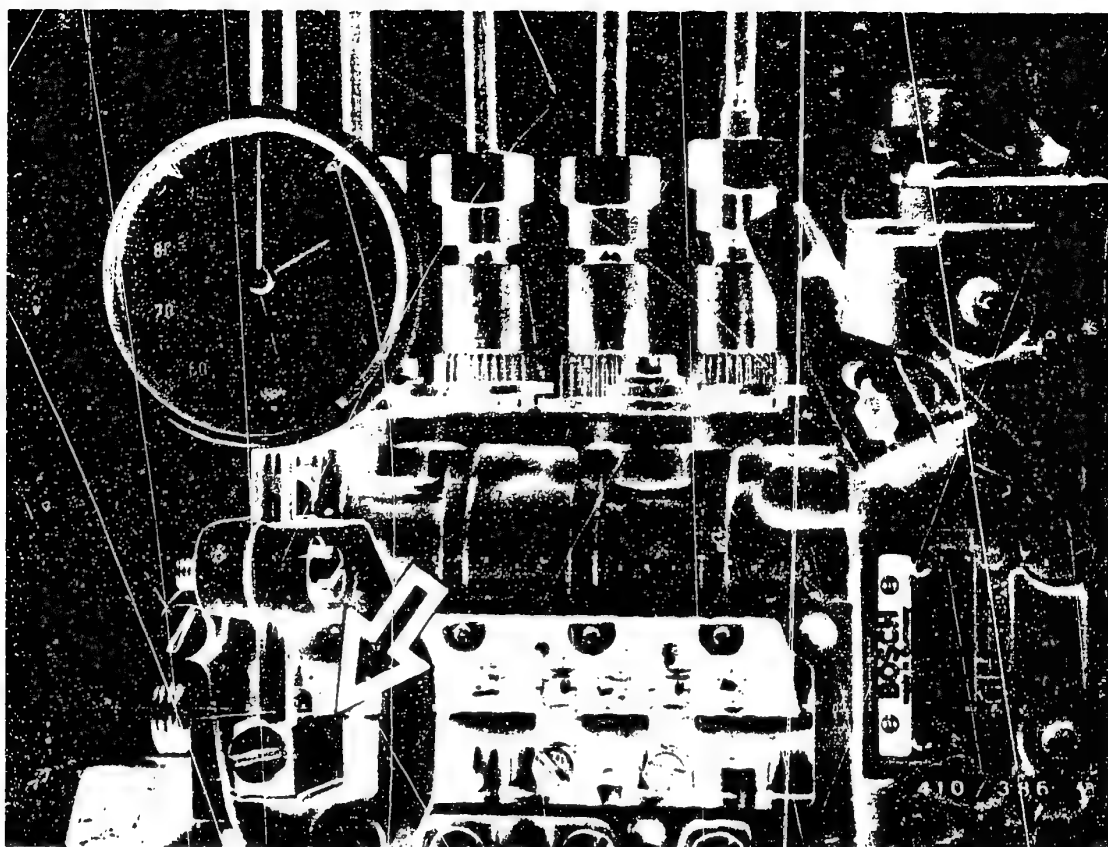
11.14 Checking prestroke and start-of-delivery setting

Mount injection pump on test bench.

Mount measuring tool 1 681 440 017 for measuring prestroke on first cylinder of injection pump (on pumps with FBG system, use the measuring tool altered per Tech. Bulletin VDT-I-400/1003).

In doing this, make sure that the feeler of the measuring tool lies on the roller tappet of the first cylinder, and is not in contact with the plunger return spring.





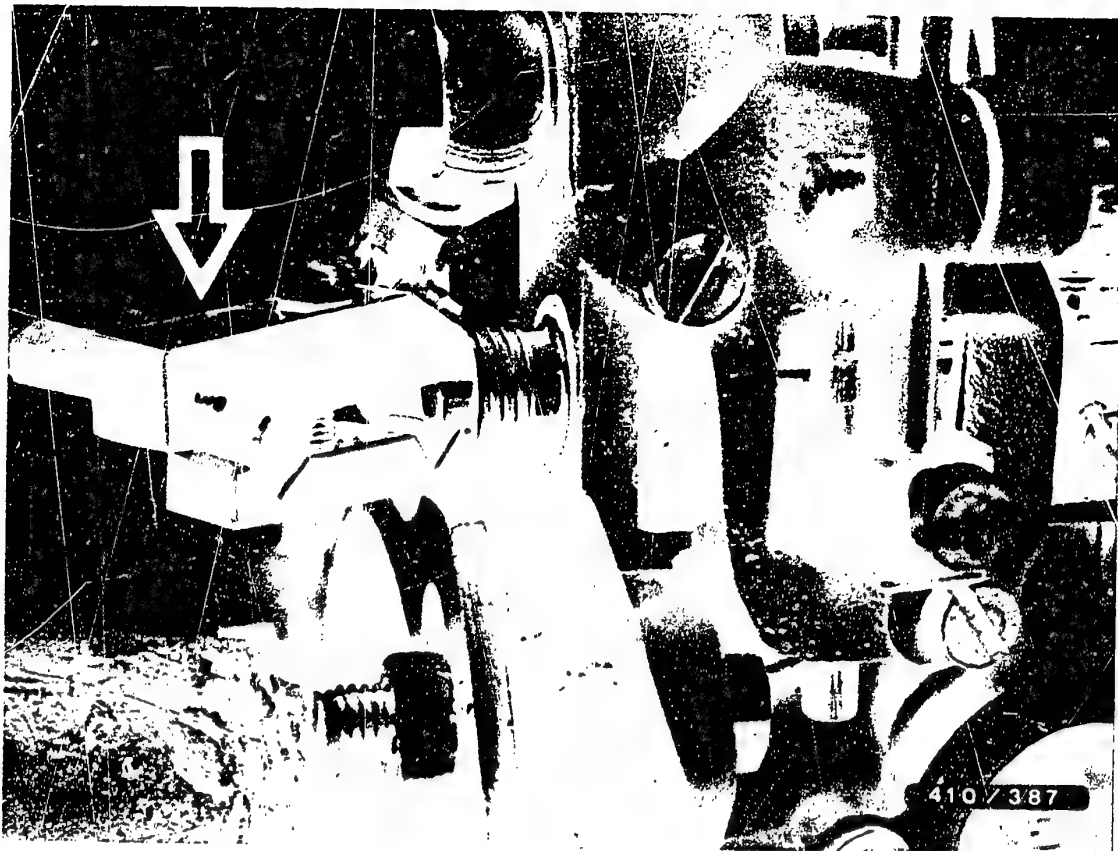
Install dial indicator 1 687 233 011 in prestroke-measuring tool and set to "0" in BTC position of roller tappet.

Connect calibrating-oil-supply and test-pressure lines to injection pump.

Note:

When the prestroke-measuring tool is mounted on the injection pump, the camshaft must not be turned through a complete revolution, as this would damage the measuring feeler.





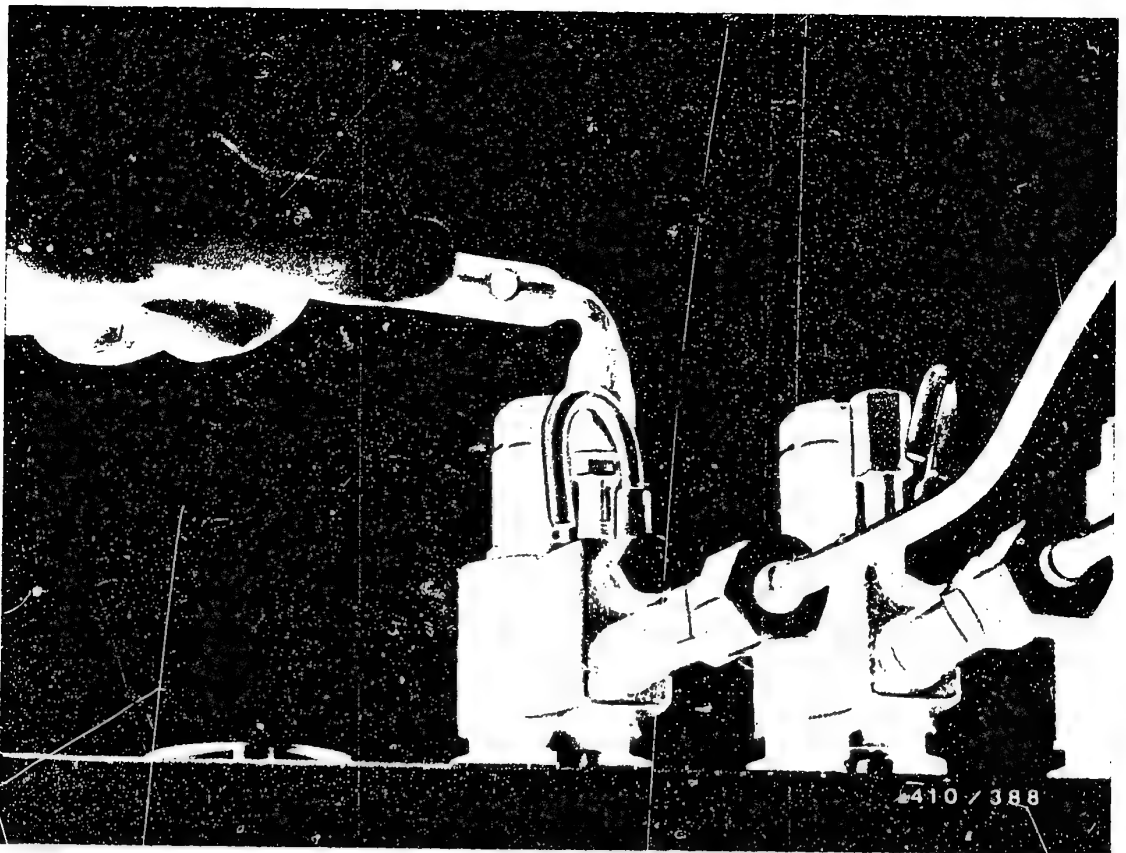
Push the control rod to stop in the direction of starting and fix in this position with the clamping piece of the control-rod-travel measuring tool (illustration).

G1

Assembling injection pump

PES..M., 0 410 ..





Open bleeder screw on overflow pipe of calibrating nozzle-holder assembly at first cylinder.

Switch on test bench and increase supply pressure until fuel exits at overflow pipe bubble-free.

Turn injection-pump camshaft in direction of pump rotation until start of delivery is reached.

Start of delivery is reached when the flow of calibrating oil at the overflow pipe of the calibrating nozzle-holder assembly turns into a series of drips.

Prestroke is the travel from the BDC position of the plunger to start of delivery.

When start of delivery is reached, read plunger stroke on dial indicator and compare with nominal value per test-specification sheet.

If nominal and actual values agree, move the indicator on the test-bench flywheel to a "whole" increment and note this value.

Dismount prestroke-measuring tool with dial indicator from injection pump.

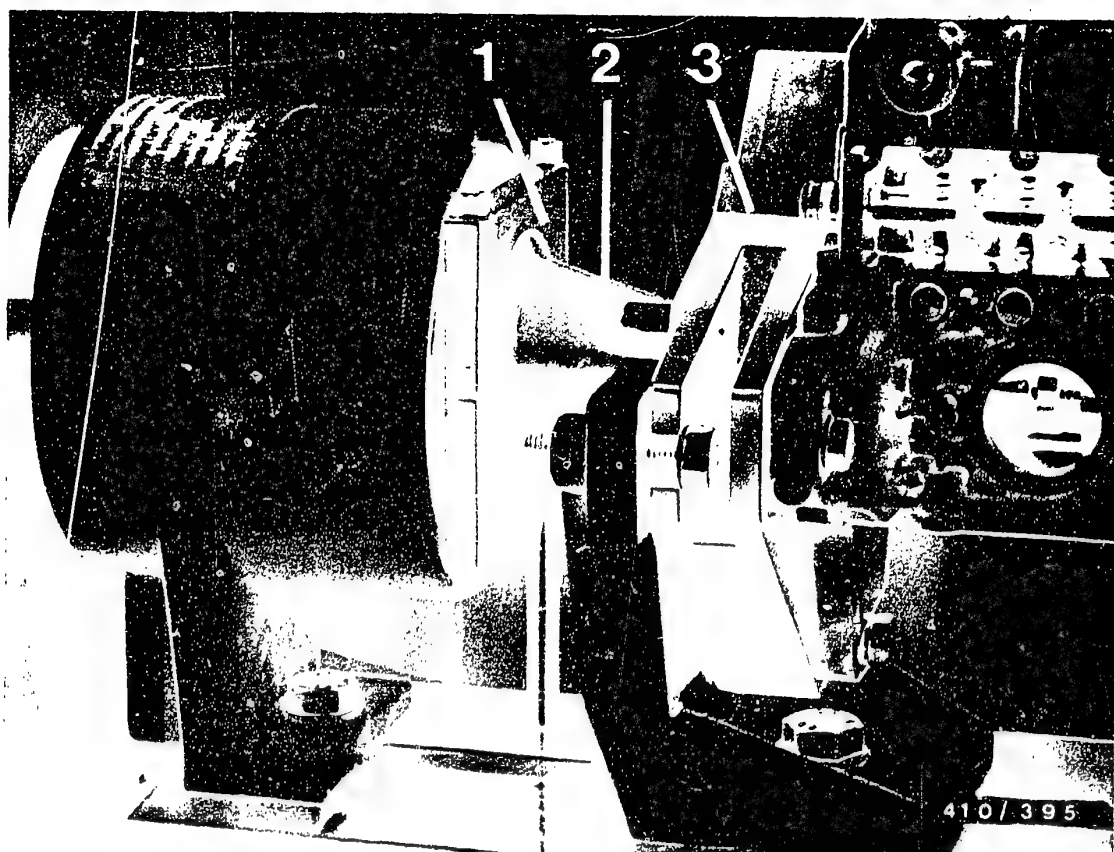
Close bleeder screw on nozzle-holder assembly of first outlet.

Open bleeder screw at nozzle-holder assembly of the next outlet in cam sequence.

Turn camshaft further in direction of pump rotation until start of delivery is reached.

In this position, read and note down the increment of the indicator of the test-bench flywheel. The difference between the increment set at the first cylinder (at nominal value) and that of the following cylinder must be as follows: on 4-cyl. pumps, $90 \pm 0.5^\circ$; on 5-cyl. pumps, $72 \pm 0.5^\circ$; on 6-cyl. pumps, $60 \pm 0.5^\circ$. Remove injection pump without FBG from test bench. Continued on Coordinate G6.





1 = Clamping device
2 = Coupling halves

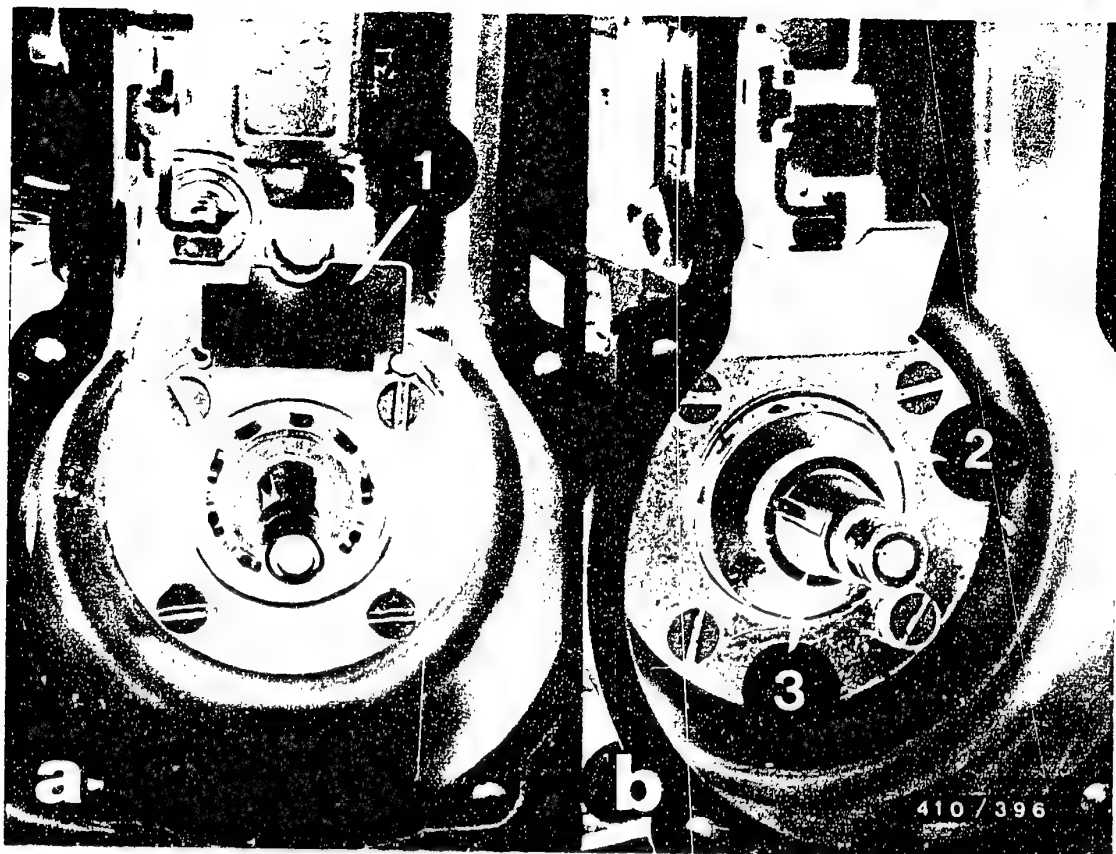
3 = Clamping flange

Text applies only to M-size pumps with FBG

After concluding prestroke and start-of-delivery testing at outlet 1, turn the camshaft further in direction of pump rotation by the amount indicated in the test-specification sheet.

Mount clamping device KDEP 1545 to coupling halves so that the stay bolt rests on the guide bed of the IP test bench (see illustration).





1 = Retaining plate
2 = Disk spring

3 = Spacer sleeve

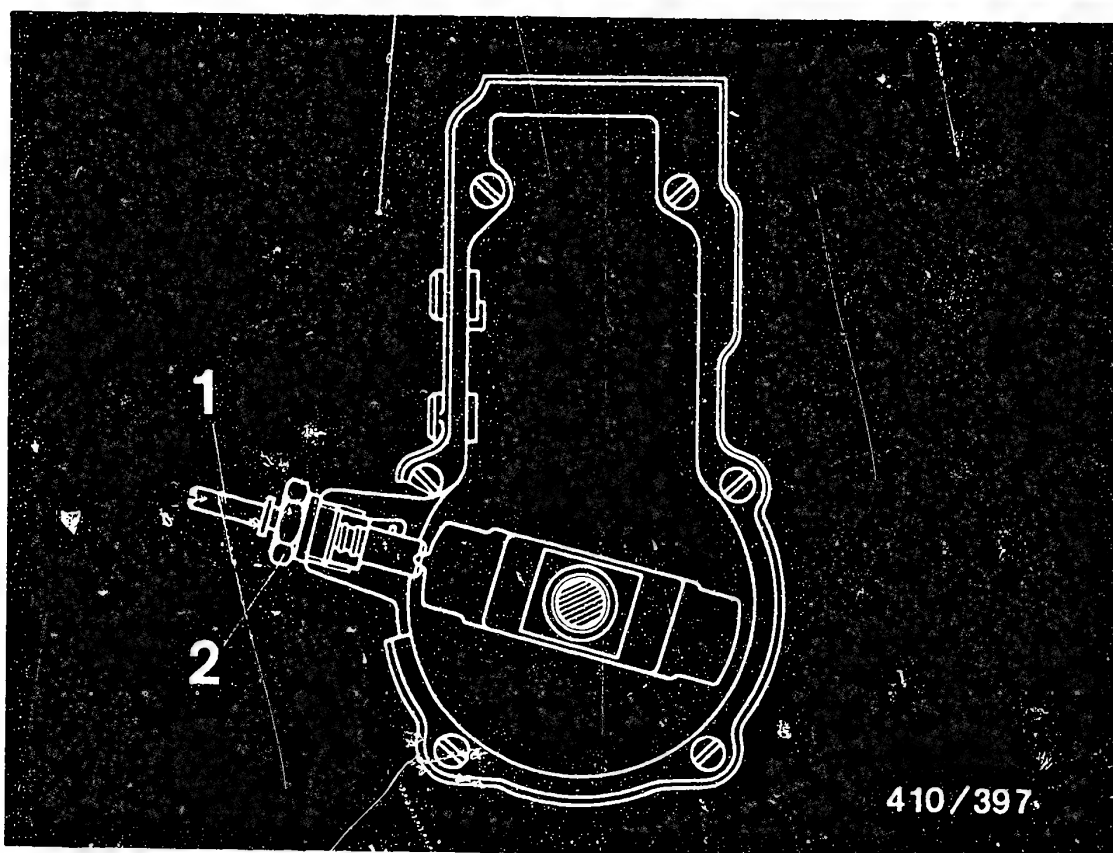
Push retaining plate onto camshaft.

Guide disk spring onto camshaft so that the raised portions lie opposite to one another.

Push spacer sleeve onto camshaft. Cone (governor side) of camshaft must be grease-free before installation of the flyweight assembly.

Note:

Do not install Woodruff keys on pumps with FBG.



1 = Holding device KDEP-1077

2 = Union nut

Mount flyweight assembly on camshaft. Align flyweight with sensor hole and fix it exactly in this position with holding device KDEP-1077. Start flyweight fastening nut and tighten to a pre-tightening torque of 20 + 10 Nm.

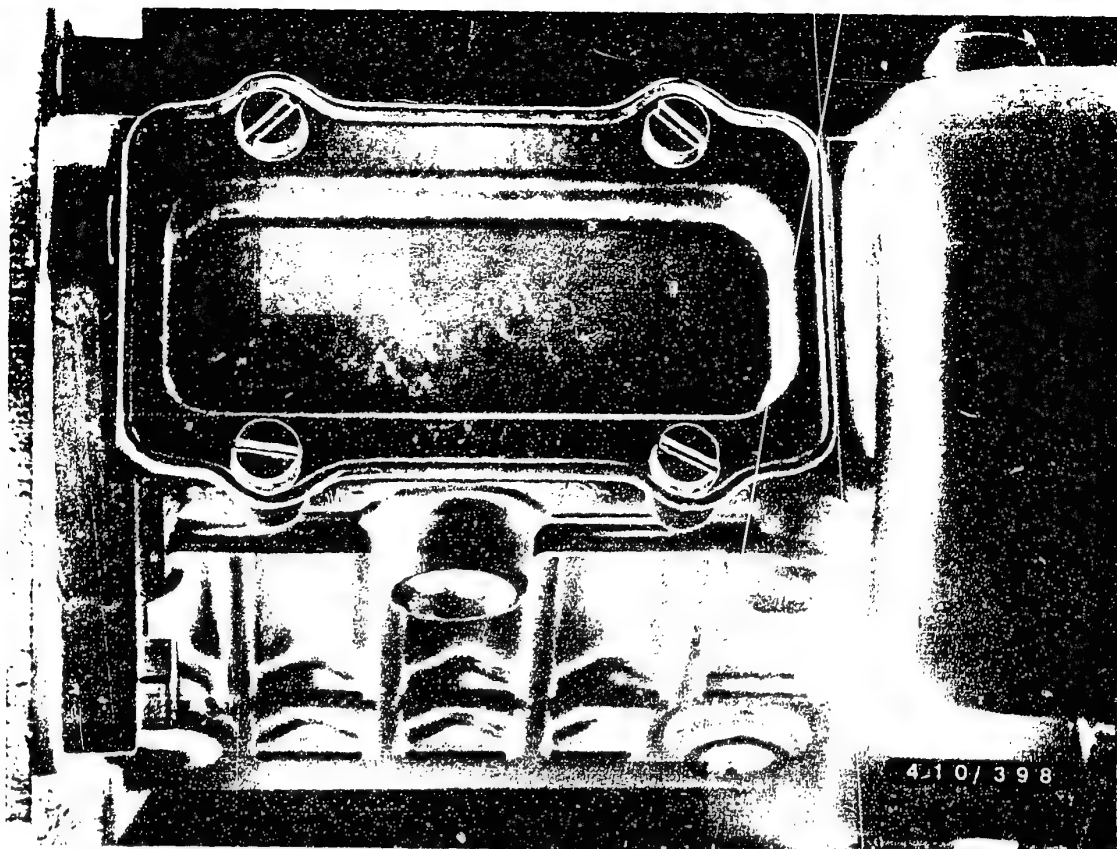
Remove holding device KDEP-1077 and tighten flyweight fastening nut to 50-60 Nm. Remove clamping device KDEP 1545.



Checking assembly of flyweight

- Again set start of delivery (series of drips at overflow pipe of calibrating nozzle-holder assembly for cylinder 1)
- Position indicator on flywheel at a whole increment
- Add nominal value (per test-specification sheet) and turn camshaft to this value.
- Screw in holding device KDEP 1077.
- Check whether flyweight lug has engaged. If necessary, bring about engagement by turning camshaft.
- Read actual value on flywheel.
- If necessary, remount flyweight as described and check setting again.
- Remove injection pump from test bench.



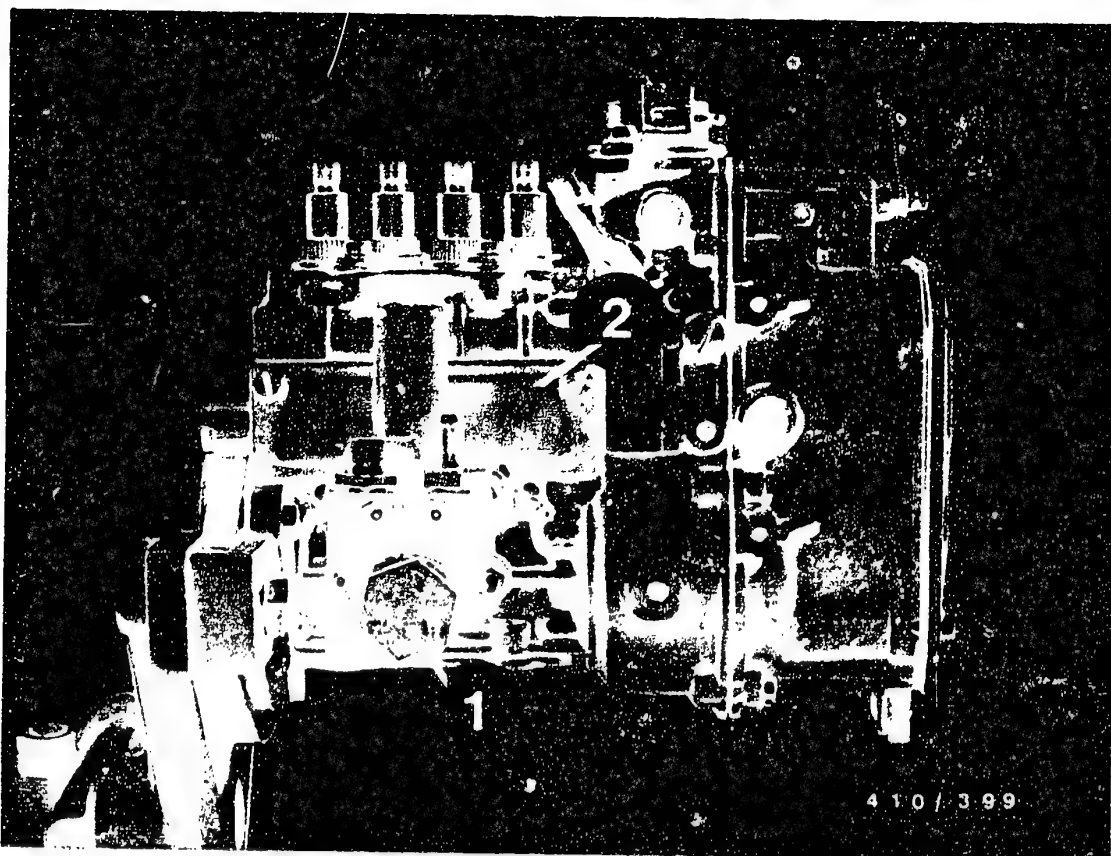


11.15 Mounting base cover plate

After completing prestroke adjustment, mount injection pump on assembly support KDEP 2919.

Swing pump and affix base cover plate.





1 = Fuel-supply pump

2 = Spring-chamber cover

Assemble governor per appropriate repair instructions.

Mount fuel-supply pump and spring-chamber cover only after adjustment on IP test bench.

Remove injection pump from assembly support.

Note:

If injection pump is not to be immediately adjusted, mount the above-specified parts.

G9

Assembling injection pump

PES..M., 0 410 ..



11.16 Leak test of camshaft and spring chamber,
governor chamber

Completely assemble injection pump.

Mount appropriate test bell - without FBG KDEP 1065,
with FBG KDEP 1566 - on bearing end plate.

Immerse injection pump vertically in test bath.

Test duration and pressure:

- 3 minutes at 1.5 bar, then 1 minute at 0.5 bar

Ascertain by visual inspection that no sealing
surfaces, thread connections, seal rings and end
covers on housing and cover show leakage.

No air bubbles must be visible.

In order to avoid possible skin irritation, prior to
this testing rub a protective hand cream into the
hands, and after the test wash with soap and water.



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MOUNTING OF DRIVE-END BEARING END PLATE
ON INJECTION PUMPS PES..M.. WITH RSF II
GOVERNOR, 0 400 07 ..

40...46, 58

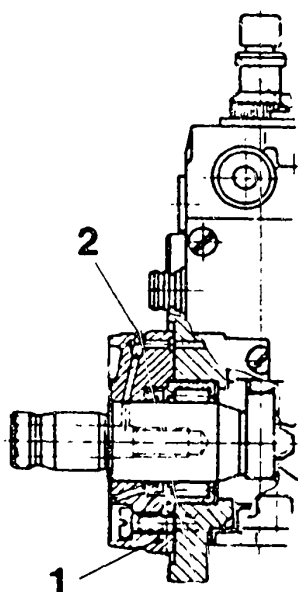
VDT-I-400/114 En

4.1984

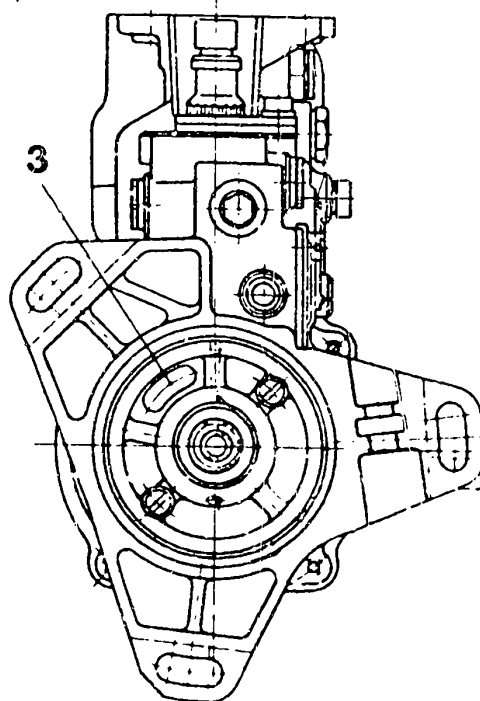
On the above-mentioned injection pumps the drive-end bearing end plate has an oil inlet bore and an annular orifice (as oil return).

When mounting the bearing end plate, the annular orifice must be at the top left, looking onto the drive (see picture below).

If the bearing end plate is mounted incorrectly, the lubricating-oil circuit between pump and timing device is interrupted.



1 = Bearing end plate
2 = Oil inlet bore



3 = Annular orifice

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N1

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PES..M..., 0 410..



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MODIFICATION TO THE PRESTROKE MEASURING DEVICE

0 681 440 017 FOR FUEL-INJECTION PUMPS

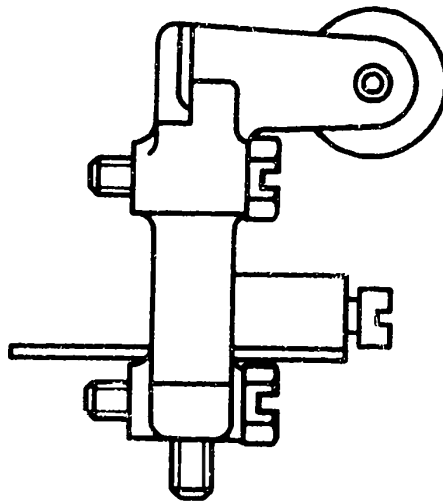
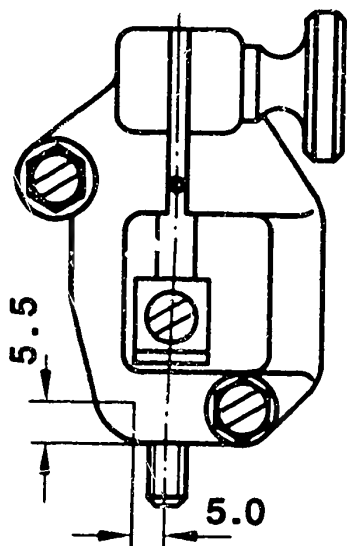
0 400 07. ..

VDT-I-400/1003 En

3.1984

Due to the larger-size pump flange on the M-pumps with governor RSF II (new generation), the prestroke measuring device 0 681 440 017 at present in use can no longer be fitted. It can be adapted, though, by filing a step as shown in the diagram.

New prestroke measuring devices have already been modified accordingly.



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PES..M.., 0 410..



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Introduction of micro-encapsulated roller tappet fixing screws in PES 3 and 4 M..C..

41

VDT-I-410/103 En
2.1978

Instead of the previously used roller-tappet fixing screws 1 413 417 096 (item 9 in service-part microfiche), screws 1 413 417 003 have been in use since June 1977 in PES 3 and 4 M..C.. fuel-injection pumps. These screws are of the micro-encapsulated type, this feature rules out the possibility of their working loose.

Consequently, the spring-chamber closing cover no longer requires locking strips 1 411 035 001 (item 51 in PES 4 M..C..) and 1 411 035 002 (item 47 in PES 3 M..C..).

These micro-encapsulated screws 1 413 417 003 may be used once only and must be replaced each time repair work is performed. Please order these screws immediately. It should be noted that the shelf life of these micro-encapsulated screws is only approx. 2 years.

Fuel-injection pumps still with locking strips fitted to the spring-chamber closing cover need not be converted to this new type of locking. The strips are still available as individual items or in parts set 1 417 010 001 (for PES 4 M..C..).

Until you have a stock of these new micro-encapsulated screws, locking strips can be fitted to the spring-chamber closing cover when performing repair work on fuel-injection pumps without such strips.

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N3

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PES..M.., 0 410..



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MODIFIED SUPPORT CLAMP
AND BUSHINGS

VDT-I-420/111 En
2.1982

Fuel-injection pump size M

For technical reasons shorter support clamps (item 58) and longer bushings (item 14) (see Fig. 2) are being used with fuel-injection pumps size M with RSF governor and with new fuel-injection pumps size M with RSV governor (recognizable by the dome on the housing - see Fig. 1, arrow).

Bild 1

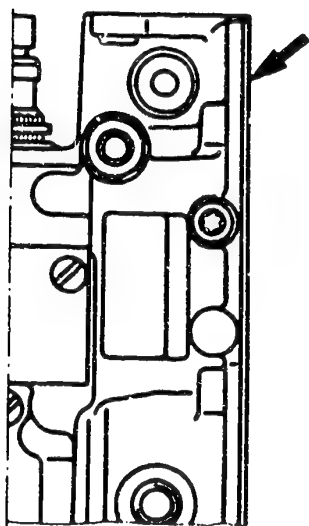
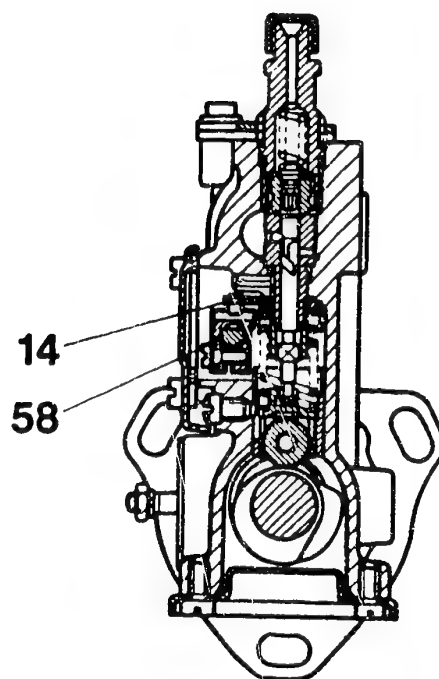


Bild 2



This modification has not been carried out with the pneumatic governor (MN) and with former M-pumps with mechanical governor (RSV).

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N4

Technical Bulletin

PES..M.., 0 410..



When repairing the fuel-injection pump the following should be observed:-

1. In M-pumps with RSF-governor and in new M-pumps with RSV-governor (recognizable by the dome on the housing) only the

bushings: 1 410 320 013
with support clamps: 1 411 315 004 (up to FD 6.80)
1 411 315 003 (from FD 7.80)

prescribed in the service-parts list may be used when repairs are carried out.

2. In M-pumps with MN-governor (pneumatic governor) and in former M-pumps with RSV-governor (mechanical governor) only the

bushings: 1 410 320 031
with support clamps: 1 411 315 001

prescribed in the service-parts list may be used when repairs are carried out.

The modified bushings and support clamps are not marked.
Please see that no confusion arises in storage.



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